CLEVELAND OPPORTUNITY CORRIDOR
OHIO DEPARTMENT OF TRANSPORTATION

Noise Analysis

Opportunity Corridor
Cuyahoga County, OH

Submitted to:

Ohio Department of Transportation
5500 Transportation Blvd
Garfield Heights, Ohio 44125

Submitted by:

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EXECUTIVE SUMMARY

This report evaluates the potential noise impacts of the proposed improvements within the Opportunity Corridor in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The noise analysis presents the existing and future acoustical environment at various receptors located along the Opportunity Corridor.

The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772) and the Ohio Department of Transportation's (ODOT) "Standard Procedure for Analysis and Abatement of Highway Traffic Noise" (Noise Policy).

Existing noise level measurements were conducted on November 18, 2010 at 25 representative sites in the project vicinity. The measurements were made in accordance with FHWA and ODOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements when traffic was visible from the site. Traffic data were obtained at 20 of the 25 field sites.

The latest version of the FHWA's Traffic Noise Model, TNM®2.5, was used to model existing (2008) and design year (2020) worst hourly traffic noise levels within the study area. 81 representative noise receptors plus the 25 field sites were modeled. These receivers were selected to model representative noise impacts at areas consisting of residential, commercial, industrial and recreational properties.

Existing design hour noise levels presently approach or exceed the FHWA/ODOT Noise Abatement Criteria (NAC) at two locations in the study area, one residence and one medical facility.

Predicted future design year (2020) noise levels adjacent to the proposed project would approach or exceed the NAC at 12 representative receptors. Nine of these locations represent residential uses and three represent medical facilities along East 105th Street. The noise levels at these 12 locations would range from 65.5 to 69.1 dBA L_{eq}(h). Predicted future noise levels that substantially exceed existing noise levels (ODOT has defined an increase over existing noise levels of 10 decibels or more as being substantial) would occur at 18 representative locations. 17 of these locations represent residential uses and one represents a commercial property.

Noise barriers were modeled at four locations along the Opportunity Corridor. ODOT's policy is to install feasible and reasonable noise barriers associated with transportation improvements. Based on the study completed, mitigation is feasible and reasonable at three of the four locations. There remain 10 receptors along the Opportunity Corridor for which noise mitigation was not feasible or reasonable. The final decision on the construction of the noise barriers will take place during final design and upon completion of the public involvement process. If it is determined during final design that conditions have substantially changed, the abatement measures will need to be reassessed.

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1.0 INTRODUCTION

The Opportunity Corridor project is located in the City of Cleveland, Cuyahoga, Ohio along the existing railroad transportation corridor that contains the rail lines owned and operated by Norfolk Southern (NS) and Greater Cleveland Regional Transit Authority (GCRTA) with the CSX mainline being the approximate eastern boundary of the study area. The purpose of the Opportunity Corridor project is to improve the transportation infrastructure, access, and mobility within a historically underserved, economically depressed area within the City of Cleveland. As part of this, the proposed project must support the City of Cleveland's efforts to revive and redevelop large tracks of vacant residential and industrial land within the City of Cleveland's southeast side.

The study area consists of residential, commercial, industrial and recreational areas. The zoning in the study area is extensively mixed, and land use varies from parcel to parcel. This area developed prior to the establishment of zoning codes resulting in residential properties being located immediately adjacent to industrial properties. Future development in the project study area will follow the City's comprehensive plan, which is entitled *Connecting Cleveland 2020 Citywide Plan*.

The Ohio Department of Transportation (ODOT) and the Federal Highway Administration (FHWA), in coordination with the City of Cleveland are undertaking the Opportunity Corridor project using federal funds. There are no funds in place at this time for the completion of contract plans, real estate acquisition, utility relocation or construction. Funds are in place for completion of the next phase – contract plans for the Woodland Avenue to Chester Avenue section. Funds are also in place for a portion of the real estate acquisition within this section. ODOT is investigating both traditional and Public Private Partnership (P3) opportunities for the overall project as part of the financial plan.

The proposed transportation infrastructure improvements would begin near I-490 at East 55th Street at the southwest and terminate along East 105th Street north of US-322 (Chester Avenue) at the northeast as shown in Figure 1. The facility, as proposed, would be a multi-lane urban arterial boulevard with wide outside travel lanes for shared use with bicycle traffic. The proposed boulevard would also include a multi-use path on the south side of the roadway and a sidewalk on the north side of the roadway. The proposed alignment is depressed under East 55th Street. As the project progresses to the east, the boulevard returns to existing street grade and includes signalization at major intersections. In addition to the grade separation at East 55th Street, grade separation structures are proposed for locations where the new roadway crosses the existing rail lines owned and operated by NS and GCRTA. Northeast of Kinsman Road, the mainline would be south of and parallel to Grand Avenue. At the intersection with East 79th Street, the mainline begins to turn to the northeast. From East 79th Street to Quincy Avenue, the boulevard parallels the GCRTA Red line/ NS Nickel Plate rail line trench to the north. Minor adjustments in direction occur at almost all intersections until just past East 93rd Street when the mainline begins a gradual turn to north so that it meets up with East 105th Street at Quebec Avenue. From Quebec Avenue to the northern terminus, East 105th Street would be generally widened along the existing alignment with variations to minimize impacts to adjacent buildings.

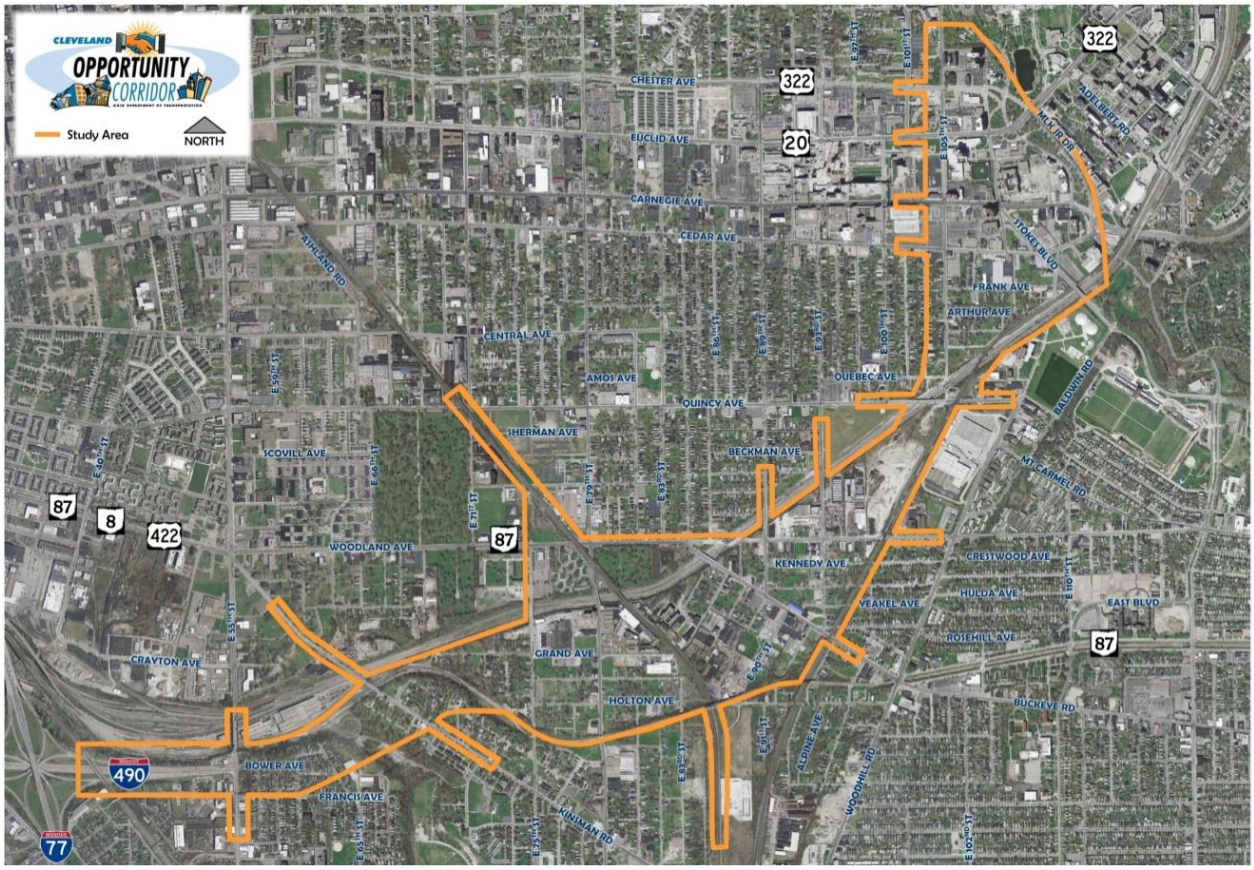


Figure 1 Project Location Map

2.0 NOISE ANALYSIS OVERVIEW

This report evaluates the potential noise impacts of the proposed improvements within the Opportunity Corridor preferred alternative in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The noise analysis presents the existing and future acoustical environment at various receptors located along the Opportunity Corridor.

The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772) and the ODOT's "Standard Procedure for Analysis and Abatement of Highway Traffic Noise (Noise Policy)".

Basic Noise Information

Noise is defined as unwanted and disruptive sound. The ear is sensitive to this pressure variation and perceives it as sound. The intensity of these pressure variations causes the ear to discern different levels of loudness. These pressure differences are most commonly measured in decibels.

The decibel (dB) is the unit of measurement for sound. The decibel scale audible to humans spans approximately 140 dB. A level of zero decibels corresponds to the lower limit of audibility, while 140 decibels produces a sensation more akin to pain than sound. The decibel scale is a logarithmic representation of the actual sound pressure variations. Therefore, a 26 percent change in the energy level only changes the sound level one dB. The human ear would not detect this change except in an acoustical laboratory. A doubling of the energy level would result in a three-dB increase, which would be barely perceptible in the natural environment. A tripling in energy sound level would result in a clearly noticeable change of five-dB in the sound level. A change of ten times the energy level would result in a ten-dB change in the sound level. This would be perceived as a doubling (or halving) of the apparent loudness.

The human ear has a non-linear sensitivity to noise. To account for this in noise measurements, electronic weighting scales are used to define the relative loudness of different frequencies. The "A" weighting scale is widely used in environmental work because it closely resembles the non-linearity of human hearing. Therefore, the unit of measurement for an A-weighted noise level is dBA.

Traffic noise is not constant. It varies as each vehicle passes through a certain location. The time-varying characteristics of environmental noise are analyzed statistically to determine the duration and intensity of noise exposure. In an urban environment, noise is made up of two distinct parts. One is ambient or background noise. Wind noise and distant traffic noise make up the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce a non-irritating ambient sound level. This background sound level varies throughout the day, being lowest at night and highest during the day. The other component of urban noise is intermittent and louder than the background noise. Transportation noise and local industrial noise are examples of this type of noise. It is for these reasons that environmental noise is analyzed statistically.

The statistical descriptor used for traffic noise is Leq. Leq is the constant, average sound level, which over a period of time contains the same amount of sound energy as the varying levels of the traffic noise. The Leq correlates reasonably well the effects of noise on people. It is also easily measurable with integrating sound level meters. The time period for traffic noise is 1-hour. Therefore, the unit of measure for traffic noise is Leq(1h) dBA.

Highway noise sources have been divided into five types of vehicles; automobiles (A), medium trucks (MT), heavy trucks (HT), Buses (B) and Motorcycles (MC). Each vehicle type is defined as follows[1]:

- Automobiles – all vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 10,000 pounds.
- Medium trucks – all vehicles having two axles and six tires, vehicle weight between 10,000 and 26,000 pounds.
- Heavy trucks – all vehicles having three or more axles, vehicle weight greater than 26,000 pounds.
- Buses – all vehicles designed to carry more than nine passengers.
- Motorcycles – all vehicles with two or three tires and an open-air driver/passenger compartment.

[1] G.S. Anderson, C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p.60.

Noise levels produced by highway vehicles can be attributed to three major categories:

- Running gear and accessories (tires, drive train, fan and other auxiliary equipment)
- Engine (intake and exhaust noise, radiation from engine casing)
- Aerodynamic and body noise

Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Change in any of these can vary noise levels. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and related accessories.

Noise Model and Analysis

The FHWA's Procedures for Abatement of Highway Traffic Noise and Construction Noise is presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772). This regulation, plus other guidance documents written to explain the regulation, sets forth the process for performing a traffic noise analysis. The process includes the following:

- Identify existing and proposed land uses in the study area;
- Determine existing noise levels either:
    - through modeling, or
    - noise measurements with concurrent classification counts of vehicles passing the noise monitoring site;
- Validate predicted noise levels through comparison between measured and predicted levels;
- Model future design year traffic noise levels which will yield the worst hourly traffic noise on a regular basis (design hour noise levels);
- Identify locations that would be exposed to a noise impact based upon the Noise Abatement Criteria (NAC) as presented in Table 1;
- Model noise abatement measures to mitigate the predicted design year traffic noise impacts; and
- Modeling must be performed with FHWA's most recent version of the Traffic Noise Model® (TNM).

ODOT's Noise Policy is the state's tool for implementing 23 CFR 772. The NAC, which is presented in 23 CFR 772, establishes the noise abatement criteria for various land uses. The noise level descriptor used is the equivalent sound level, L_{eq}, defined as the steady state sound level which, in a stated time period (usually one hour), contains the same sound energy as the actual time-varying sound.

Noise abatement measures will be considered when the predicted noise levels approach or exceed those values shown for the appropriate activity category in Table 1, or when the predicted traffic noise levels substantially exceed the existing noise levels. ODOT has defined the approach value as being 1 dBA less than the noise levels shown in Table 1. ODOT has defined an increase over existing noise levels of 10 decibels or more as being substantial.

TNM® is FHWA's "computer program for highway traffic noise prediction and analysis."[2] The following parameters are used in this model to calculate an hourly $L_{eq}(1h)$ at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;
- Hourly traffic volume in light-duty (two axles, four tires), medium-duty (two axles, six tires), and heavy-duty (three or more axles) vehicles;
- Vehicle speed;
- Ground absorption; and
- Topographic features, including retaining walls and berms.

The Opportunity Corridor study area consists of residential, commercial, industrial and recreational areas. The criteria stated in Table 1 below will help to determine whether or not the proposed project will impact uses throughout the corridor.

Table 1: Noise Abatement Criteria (NAC)
Hourly A-Weighted Sound Level-Decibels (dBA)

Activity Category	Activity Criteria $L_{eq}(h)$	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	Exterior	Residential
C	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	N/A	N/A	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	N/A	N/A	Undeveloped lands that are not permitted.

Source: "Standard Procedure for Analysis and Abatement of Highway Traffic Noise", Ohio Department of Transportation, June 7, 2011,

[2] Ibid, Report Documentation Page.

3.0 NOISE MEASUREMENTS

Existing noise level measurements were conducted on November 18, 2010 at 25 representative sites in the project vicinity. A 10 or 20-minute measurement was taken at each site. The measurements were made in accordance with FHWA and ODOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements, when traffic was visible from the site. Traffic data were obtained at 20 of the 25 field sites. The data collected at the 25 sites are presented in Table 2. The measurement locations were selected adjacent to the three preliminary alignments being studied in 2010. This noise analysis is being performed on the preferred alternative. Therefore, some of the noise measurement sites as shown on the exhibits contained in Appendix A are within the proposed right-of-way or outside the area of influence for the preferred alternative. The field data sheets are presented in Appendix B and the sound level analyzer laboratory calibration certificates are presented in Appendix C of this report.

Table 2: Measured Existing Noise Levels
Opportunity Corridor
Cleveland, OH

Field Site #	Figure #	Site Description	Date	Start Time	Duration	Traffic[1)]						Noise Level, dBA L_{eq}(1h)
						Roadway	A[a]	MT[b]	HT[c]	Buses[d]	Speed mph	
FS-1	A1	Residence, 2908 East 57th Street, 6 ft. west of East 57th Street, 95 ft. south of Bower Avenue.	11/18/10	16:49	10:00	East 57th Street	5	0	0	0	25	57.0
FS-2	A1	Residence, 5913 Bower Avenue, 6 ft. south of Bower Avenue, 10 ft. east of 59th Street.	11/18/10	17:10	10:00	No Traffic						60.0
FS-3	A1	Empty Lot at the corner of East 61st Street and Bower Avenue. East of East 61st Street and south of Bower Avenue.	11/18/10	10:55	10:00	No Traffic						58.3
FS-4	A1	At 2915 East 61st Street between Francis Avenue and Carpenter Avenue, 10 ft. east of East 61st Street.	11/18/10	16:52	10:00	Francis Avenue	5	0	0	0	25	57.1
FS-5	A1, A2	Back of the sidewalk on an empty lot, 8 ft. south of Butler Avenue, 7 ft. west of East 64th Street.	11/18/10	10:53	10:00	Butler Avenue	2	0	0	0	25	57.7
FS-6	A2	Empty Lot on Berwick Road, 20 ft. southwest of Berwick Road, 80 ft. southeast of the residence at East 6620 Berwick Road.	11/18/10	16:17	20:00	Kinsman Road	434	3	0	7	35	57.6
						Berwick Road	4	0	0	0	30	
FS-7	A2	Empty Lot on Colfax Road in between East 68th Street and East 69th Street, 14 ft. from Colfax Road.	11/18/10	16:20	10:00	Colfax Road	6	0	0	0	30	59.0
FS-8	A2	Empty Lot on Grand Avenue in between East 71st Street and East 73rd Street, 45 ft. north of Grand Avenue.	11/18/10	11:25	20:00	Grand Avenue	11	0	0	0	25	55.1
FS-9	A2	At the residence of 2758 East 73rd Street, west of East 73rd Street, south of Grand Avenue.	11/18/10	11:25	20:00	No Traffic						50.9
FS-10	A3	Empty Lot on East 75th Street between Rawlings Avenue and Grand Avenue, 38 ft. east of East 75th Street.	11/18/10	11:58	20:00	East 75th Street	30	2	0	0	25	56.1

Field Site #	Figure #	Site Description	Date	Start Time	Duration	Traffic[1)]						Noise Level, dBA L_{eq}(1h)
						Roadway	A[a]	MT[b]	HT[c]	Buses[d]	Speed mph	
FS-11	A2, A3	Empty Lot on East 75th Street in between Rawlings Avenue and Holton Avenue, 130 ft. south of Rawlings Avenue, 110 ft. east of East 75th Street.	11/18/10	11:56	20:00	East 75th Street	33	0	0	1	25	53.3
FS-12	A3	Empty Lot on Rawlings Avenue, in between East 75th Street and East 79th Street, 31 ft. south of Rawlings Avenue.	11/18/10	12:30	10:00	No Traffic						53.3
FS-13	A3	Empty Lot on East 79th Street in between Grand Avenue and Rawlings Avenue, 25 ft. west of East 79th Street, 88 ft. south of the residence at 2783 East 79th Street.	11/18/10	12:29	20:00	East 75th Street	138	3	1	0	25	63.0
FS-14	A3	Union Hill Missionary Baptist Church on Rawlings Avenue, 17 ft. north of Rawlings Ave.	11/18/10	12:44	10:00	Rawlings Road	3	0	0	0	25	54.7
FS-15	A3, A4	Empty Lot at the corner of Lisbon Road and Evins Avenue, 31 ft. southeast of Lisbon Road, 9 ft. northeast of Evins Avenue.	11/18/10	13:05	10:00	No Traffic						57.6
FS-16	A4	Empty Lot on Grand Avenue, 20 ft. northwest of Grand Avenue, 20 ft. northeast of 2668 Grand Avenue.	11/18/10	13:21	20:00	Grand Avenue	5	0	0	0	25	55.8
FS-17	A3, A4	Empty Lot on Evarts Road, 130 ft. southeast of Grand Avenue, 20 ft. northeast of Evarts Road.	11/18/10	13:04	10:00	Evarts Road	1	0	0	0	25	52.5
FS-18	A4	Empty Lot on Buckeye Road in between Grand Avenue and Tennyson Road, 34 ft. southwest of Buckeye Road.	11/18/10	13:22	20:00	Buckeye Road	222	7	0	0	35	66.3
FS-19	A3, A4	Corner of a Parking Lot on Tennyson Road, 10 ft. northeast of Tennyson Road, 10 ft. southeast of a garage at 2765 Tennyson Road.	11/18/10	13:52	20:00	Buckeye Road	222	7	0	0	35	56.7
FS-20	A4	Empty Lot on East 89th Street in between Kennedy Avenue and Woodland Avenue, 25 ft. south of East 89th Street, 30 ft. east of Kennedy Avenue.	11/18/10	14:08	20:00	East 89th Street	57	0	0	1	25	58.3
FS-21	A4	At Kenneth L. Johnson Park at the corner of East 93rd Street and Woodland Avenue, 43 ft. south of Woodland Avenue, 40 ft. west of East 93rd Street.	11/18/10	14:11	20:00	Woodland Avenue	133	11	5	0	35	63.1
FS-22	A6	Empty Lot on East 105th Street, 32 ft. north of fence at Crosstown Food Market, 17 ft. south of Wain Court.	11/18/10	15:40	20:00	East 105th Street	336	5	6	4	25	56.4

Field Site #	Figure #	Site Description	Date	Start Time	Duration	Traffic[1]						Noise Level, dBA L_{eq}(1h)
						Roadway	A[a]	MT[b]	HT[c]	Buses[d]	Speed mph	
FS-23	A6	Empty Lot on East 105th Street, 35 ft. west of East 105th Street, 15 ft. south of Wain Court.	11/18/10	15:39	20:00	East 105th Street	336	5	6	4	25	63.8
FS-24	A6	Empty Lot on East 105th Street, 38 ft. west of East 105th Street.	11/18/10	14:47	20:00	East 105th Street	231	5	5	8	25	70.4
FS-25	A6	Empty Lot on East 105th Street, 66 ft. east of East 105th Street, 26 ft. north of Arthur Avenue.	11/18/10	14:48	20:00	East 105th Street	243	7	6	5	25	62.5

1) Vehicle counts classified as follows:
   a. Autos (A) defined as vehicles with 2-axles and 4-tires.
   b. Medium trucks (MT) defined as vehicles with 2-axles and 6-tires.
   c. Heavy trucks (HT) defined as vehicles with 3 or more axles.
   d. Buses defined as vehicles carrying more than 9 passengers.

Source: HNTB Corporation, November 2010

Measured vs. Modeled

TNM® 2.5 was used to validate the predicted noise levels through comparison with the measured and predicted noise levels. Traffic, when visible from the measurement site, was counted and classified concurrently with each noise measurement by vehicle type: cars, medium trucks, heavy trucks, and buses. Traffic counts, concurrent with the noise measurements, were taken at 20 of the 25 measurement sites. The traffic data from these 20 sites were used in the model. Eight of the field site modeled data compared within 0-3 dB of the measured levels. The second by second noise level data from the 17 remaining measurement sites were reviewed and compared to field notes to see if events such as airplanes, sirens, train horns, train or rail transit events could be removed from the data leaving only local traffic noise. It was possible to remove events from 10 of the measurement sites. However, this only added two more sites where the modeled data compared within 0-3 dB of the measured levels.

The winds were from the west the entire day, with ground level speeds of 9 - 12 mph. At the far west end of the project, traffic on I-490 and/or East 55th Street was audible at FS 1 – 3 and 5. The noise level at FS-15 was controlled by a ventilation system from a small manufacturing facility. Most of the remaining noise monitoring sites had measured noise levels in the mid to high 50 dB(A) L_{eq}(1h) range and adjusted noise levels in the lower to mid 50 dB(A) L_{eq}(1h) range which was typically substantially greater than the modeled noise levels. With the measured ambient noise levels being controlled by the general background noise levels in the Opportunity Corridor study area, not by local traffic, the measured noise levels from 15 noise monitoring sites were used to determine the existing noise levels for the receivers in the same acoustical environment as the measurement sites. The site by site comparison is presented in Table 3.

Table 3: Comparison of Measured and Modeled Noise Levels
Opportunity Corridor
Cleveland, OH

Field Site	Figure #	Noise Level, dBA L_{eq}(1h)		Difference in Noise Level, dBA L_{eq}(1h) (Modeled Minus Measured)[2]
		Measured[1]	Modeled	
FS-1	A1	57.0	57.3	0.3
FS-2	A1	60.0	55.9	-4.1
FS-3	A1	58.3	53.3	-5.0
FS-4	A1	57.1	52.8	-4.3
FS-5	A1, A2	57.7 (57.2)	51.7	-6.0 (-5.5)
FS-6	A2	57.6	53.6	-4.0
FS-7	A2	59.0 (56.3)	53.9	-5.1 (-2.4)
FS-8	A2	55.1 (53.7)	46.0	-9.1 (-7.7)
FS-9	A2	50.9 (49.2)	40.8	-10.1 (-8.4)
FS-10	A3	56.1	53.4	-2.7
FS-11	A2, A3	53.3	49.8	-3.5
FS-12	A3	53.3 (51.2)	43.2	-10.1 (-8.0)
FS-13	A3	63.0	59.2	-3.8
FS-14	A3	54.7 (52.3)	48.0	-6.7 (-4.3)
FS-15	A3, A4	57.6 (56.9)	42.6	-15.0 (-14.3)
FS-16	A4	55.8 (53.3)	52.7	-3.1 (-0.6)
FS-17	A3, A4	52.5 (51.0)	47.1	-5.4 (-3.9)
FS-18	A4	66.3	63.9	-2.4
FS-19	A3, A4	56.7	53.6	-3.1
FS-20	A4	58.3	55.6	-2.7
FS-21	A4	63.1	61.5	-1.6
FS-22	A6	56.4	53.9	-2.5
FS-23	A6	63.8	62.1	-1.7
FS-24	A6	70.4 (65.3)	61.5	-8.9 (-3.8)
FS-25	A6	62.5	61.1	-1.4

1. (XX.X) Adjusted based on second by second review of measured noise data and field notes.
2. (X.X) Difference in noise level, dBA Leq(1h), modeled minus adjusted measured.
Source: HNTB Corporation, October 2012

4.0 NOISE MODELING

The latest version of the FHWA's Traffic Noise Model, TNM®2.5[3], was used to model existing (2008) and design year (2020) worst hourly traffic noise levels within the study area. 81 representative noise receptors, numbered N1 through N81, plus the 25 field sites, FS-1 through FS-25, as shown in the exhibits contained in Appendix A, were modeled. These receivers were selected to model representative noise impacts at areas consisting of residential, commercial, industrial and recreational properties. The hourly traffic data used in the existing and future noise models are presented in Appendix D. The results of the computer modeling are presented in Table 4.

Table 4: Design Hour Noise Levels, dBA Leq(1h)
Opportunity Corridor
Cleveland, OH

Receiver Location	Figure #	Land Use	Activity Category	FHWA/ODOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Predicted Existing (2008)	Predicted Build (2020)	Change (Fut – Ex)
FS-1	A1	Within Future Right of Way	N/A	N/A	--	--	--
N1	A1	Residential	B	67	55.4	58.0	2.6
N2	A1	Residential	B	67	53.0	55.6	2.6
N3	A1	Residential	B	67	51.1	52.8	1.7
N4	A1	Vacant	G	N/A	50.9	53.7	2.8
N5	A1	Residential	B	67	51.8	55.8	4.0
N6	A1	Residential	B	67	52.5	56.6	4.1
FS-4	A1	Residential	B	67	57.1[2]	52.7	-4.4
FS-2	A1	Residential	B	67	60.0[2]	60.0	0.0
N7	A1	Residential	B	67	53.1	57.5	4.4
N8	A1	Residential	B	67	52.9	56.3	3.4
FS-3	A1	Vacant	G	N/A	58.3[2]	54.7	-3.6
N9	A1	Residential	B	67	58.3[2]	61.3	3.0
N10	A1	Vacant	G	N/A	58.3[2]	61.8	3.5
N11	A1	Vacant	G	N/A	58.3[2]	62.9	4.6
N12	A1, A2	Residential	B	67	57.2[2]	63.2	6.0
FS-5	A1, A2	Vacant	G	N/A	57.2[2]	64.0	6.8
N13	A2	Residential	B	67	57.2[2]	62.6	5.4
N14	A2	Residential	B	67	57.2[2]	58.6	1.4
N15	A2	Vacant	G	N/A	56.8	56.7	-0.1
FS-6	A2	Within Future Right of Way	N/A	N/A	--	--	--
N16	A2	Residential	B	67	61.1	62.0	0.9
N17	A2	Vacant	G	N/A	67.5	68.0	0.5
N18	A2	Residential	B	67	**67.8**	**67.5**	-0.3
N19	A2	Vacant	G	N/A	63.3	69.1	5.8
N20	A2	Residential	B	67	61.0	60.7	-0.3
FS-7	A2	Within Future Right of Way	N/A	N/A	--	--	--
N21	A2	Residential	B	67	53.2	**65.5**	**12.3**
N22	A2	Residential	B	67	53.0	63.4	**10.4**

[3] M.C. Lau, C.S.Y. Lee, J.L. Rochat, E.R. Boeker, and G.C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004

Receiver Location	Figure #	Land Use	Activity Category	FHWA/ODOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Predicted Existing (2008)	Predicted Build (2020)	Change (Fut – Ex)
N23	A2	Residential	B	67	52.3	62.6	**10.3**
N24	A2	Residential	B	67	49.2[2]	63.7	**14.5**
N25	A2	Residential	B	67	49.2[2]	60.6	**11.4**
N26	A2	Residential	B	67	49.2[2]	59.6	**10.4**
N27	A2	Residential	B	67	49.2[2]	**67.4**	**18.2**
N28	A2	Residential	B	67	49.2[2]	64.0	**14.8**
N29	A2	Residential	B	67	49.2[2]	60.9	**11.7**
N30	A2	Residential	B	67	49.2[2]	59.4	**10.2**
N31	A2	Residential	B	67	49.2[2]	58.7	9.5
N32	A2, A3	Vacant	G	N/A	51.5	63.3	11.8
N33	A2	Commercial	E	72	47.5	62.4	**14.9**
N34	A2	Residential	B	67	49.2[2]	65.3	**16.1**
FS-8	A2	Vacant	G	N/A	53.7[2]	58.8	5.1
N35	A2	Residential	B	67	49.2[2]	**66.9**	**17.7**
N36	A2	Residential	B	67	49.2[2]	**67.3**	**18.1**
FS-9	A2	Vacant	G	N/A	49.2[2]	69.5	20.3
N37	A2	Vacant	G	N/A	48.5	66.7	18.2
FS-11	A2, A3	Vacant	G	N/A	53.3[2]	59.5	6.2
FS-12	A3	Residential	B	67	51.2[2]	64.3	**13.1**
N38	A3	Residential	B	67	52.1	63.9	**11.8**
FS-10	A3	Vacant	G	N/A	53.9	66.9	13.0
N39	A3	Vacant	G	N/A	50.0	67.1	17.1
N40	A3	Vacant	G	N/A	52.7	65.8	13.1
N41	A3	Residential	B	67	62.7	**66.2**	3.5
FS-13	A3	Vacant	G	N/A	63.0[2]	68.3	5.3
N42	A3	Vacant	G	N/A	56.3	66.7	10.4
N43	A3	Place of Worship	C	67	52.3[2]	59.7	7.4
FS-14	A3	Place of Worship	C	67	52.3[2]	57.3	5.0
FS-17	A3, A4	Vacant	G	N/A	51.0[2]	67.2	16.2
FS-19	A3, A4	Commercial	E	72	56.7[2]	66.2	9.5
N44	A4	Place of Worship	D[1]	52	36.5	39.5	3.0
N45	A3	Vacant	G	N/A	59.8	66.5	6.7
FS-15	A3, A4	Within Future Right of Way	N/A	N/A	--	--	--
N46	A3, A4	Residential	B	67	56.9[2]	58.7	1.8
N47	A3, A4	Residential	B	67	56.9[2]	57.9	1.0
N48	A4	Residential	B	67	56.9[2]	57.5	0.6
N49	A4	Residential	B	67	52.9	58.7	5.8
N50	A4	Residential	B	67	53.2	**65.5**	**12.3**
N51	A4	Residential	B	67	54.5	64.1	9.6
FS-16	A4	Vacant	G	N/A	54.5	62.3	7.8
N52	A4	Residential	B	67	58.7	63.0	4.3
N53	A4	Residential	B	67	56.7	**69.1**	**12.4**
N54	A4	Residential	B	67	57.9	**67.5**	9.6
FS-18	A4	Vacant	G	N/A	62.7	70.3	7.6
N55	A4	Residential	B	67	56.9	59.2	2.3
N56	A4	Within Future Right of Way	N/A	N/A	--	--	--
FS-20	A4	Vacant	G	N/A	56.4	63.9	7.5
N57	A4	Vacant	G	N/A	57.8	67.2	9.4

Receiver Location	Figure #	Land Use	Activity Category	FHWA/ODOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Predicted Existing (2008)	Predicted Build (2020)	Change (Fut – Ex)
N58	A4	Vacant	G	N/A	68.1	69.6	1.5
FS-21	A4	Recreational	C	67	--	--	--
N59	A4	Vacant	G	N/A	56.6	67.6	11.0
N60	A4	Vacant	G	N/A	57.4	65.0	7.6
N61	A4	Industrial	F	N/A	61.4	63.0	1.6
N62	A4, A5	Residential	B	67	49.8	53.6	3.8
N63	A6	Vacant	G	N/A	60.1	64.8	4.7
N64	A6	Vacant	G	N/A	60.0	65.5	5.5
N65	A6	Residential	B	67	59.2	64.6	5.4
FS-25	A6	Vacant	G	N/A	59.8	65.3	5.5
N66	A6	Vacant	G	N/A	57.8	63.2	5.4
N67	A6	Vacant	G	N/A	55.2	61.0	5.8
N68	A6	Vacant	G	N/A	58.6	59.2	0.6
FS-24	A6	Vacant	G	N/A	65.3[2]	64.7	-0.6
FS-22	A6	Vacant	G	N/A	53.9	58.9	5.0
FS-23	A6	Vacant	G	N/A	60.9	65.0	4.1
N69	A6	Vacant	G	N/A	62.4	66.2	3.8
N70	A6	Medical Facility	C	67	64.1	**66.7**	2.6
N71	A6, A7	Medical Facility	C	67	61.3	63.1	1.8
N72	A6, A7	Medical Facility	C	67	**66.4**	**68.1**	1.7
N73	A7	Medical Facility	C	67	56.3	58.9	2.6
N74	A7	Medical Facility	C	67	64.9	**66.3**	1.4
N75	A7	Charity	C	67	60.8	61.6	0.8
N76	A7	Charity	C	67	59.9	61.8	1.9
N77	A7	Charity	C	67	55.9	56.8	0.9
N78	A7	Place of Worship	D[1]	52	41.4	42.4	1.0
N79	A7	Residential	B	67	48.7	49.3	0.6
N80	A7	Residential	B	67	46.2	48.0	1.8
N81	A7	Medical Facility	C	67	60.5	63.7	3.2

- Indicates impacted receptor. A receptor is impacted if:

A. The predicted noise level approaches or exceeds ODOT NAC, as shown on Table 1; or
B. The difference in the predicted future noise level minus the predicted existing noise level is 10.0 dB(A) or more.

1. No areas of frequent human use, Activity Category D applies and interior noise levels were developed.
2. Noise level is the measured or adjusted measured noise level from Table 3 for the areas where the measured noise levels did not validate within 0-3 dB of the modeled data levels.

5.0 IMPACT ASSESSMENT

Existing design hour noise levels presently approach or exceed the NAC at two locations in the study area, one residence and one medical facility.

Predicted future design year (2020) noise levels adjacent to the proposed project would approach or exceed the NAC at 12 representative receptors. Nine of these locations represent residential uses and three represent medical facilities. The noise levels at these 12 locations would range from 65.5 to 69.1 dBA $L_{eq}(h)$.

Predicted future noise levels that substantially exceed existing noise levels (ODOT has defined an increase over existing noise levels of 10 decibels or more as being substantial) would occur at 18 representative locations. 17 of these locations represent residential uses and one represents a commercial property.

Two places of worship were exposed to exterior noise levels that approached or exceeded the NAC of 67 dBA $L_{eq}(h)$, N44 and N78. However, neither location had an area of frequent human use adjacent to the Opportunity Corridor. Therefore, Activity Category D was applied and the interior noise levels were developed by subtracting 25 decibels from the exterior noise levels, since both structures were masonry and had air conditioning. The interior noise levels did not approach the 52 dB(A) Activity Category D Criteria in Table 1.

Within the framework of ODOT's criteria, various methods were reviewed to mitigate the noise impact of the proposed improvements. Among those considered were traffic management measures (reduction of speed limits, restriction of truck traffic to specific times of the day, a total prohibition of trucks), alteration of horizontal and vertical alignments, acquisition of real property or interests therein to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise, and noise insulation of Activity Category D land use facilities listed in Table 1, the construction of berms, and the construction of noise barriers.

Reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed roadway is also reduced. Restriction or prohibition of trucks is counter to the project purpose and need. Design criteria, recommended termini and the preliminary design process leading to the preferred alternative preclude substantial horizontal and vertical alignment shifts that would produce noticeable changes in the projected acoustical environment. Acquisition of undeveloped property for buffer zones is typically neither feasible nor reasonable due to the amount of land needed to create an acoustically effective buffer zone and the desire to keep as much land as possible in the local community's tax base. Noise insulation of the Activity Category D receptors was not required as none of the receptors were exposed to noise levels that approached or exceeded the NAC. The construction of noise berms is neither feasible nor reasonable because of the amount of space that would be required. Therefore, only the construction of noise barriers was reviewed.

Based on the future design year noise levels, four noise barriers in residential areas were modeled:

- Noise Barrier 1 – South side of the OC mainline between Kinsman Road and the east end of the bridge over the GCRTA Blue and Green Line tracks (see Figure A2, Appendix A).
- Noise Barrier 2 – South side of the OC mainline between 71st Place and 75th Street (see Figure A2, Appendix A).
- Noise Barrier 3 – North side of the OC mainline between the eastern edge of the bridge over the GCRTA Blue and Green Line tracks and 75th Street (see Figure A2, Appendix A).
- Noise Barrier 4 – North side of the OC mainline between Evins Avenue and Buckeye Road (see Figure A4, Appendix A).

6.0 NOISE ABATEMENT MEASURES

The Noise Policy states that "noise abatement will be considered for all projects where noise impacts are predicted to occur and mitigation is determined to be feasible and reasonable."[4]

Factors to be considered in determining noise abatement feasibility:

> "To be feasible, a mitigation measure must be acoustically feasible and must meet engineering requirements for constructability."[5] "Factors to consider are barrier height, topography, drainage, utilities, maintenance of the abatement measure, maintenance access to adjacent properties, and access to adjacent properties."[6]
>
> "An acoustically feasible noise barrier provides a minimum 5 dB(A) reduction for 40% of the impacted receptors."[7]
>
> "Additionally, the barrier must meet requirements for safety in accordance with *ODOT's Location and Design Manual, Volume 1, Section 600, Roadside Design.*"[8]

Factors to be considered in determining reasonableness:

> "Reasonableness involves considering the combination of social, economic, and environmental factors in the evaluation of a noise abatement measure."[9]
>
> "A cost reasonable barrier does not exceed the current cost per benefited receptor for noise abatement. The current reasonable cost for noise abatement is $35,000 per benefited receptor. A benefited receptor is any receptor receiving at least a 5 dB(A) noise reduction"[10] The estimated construction costs of a noise barrier are based on a unit cost of $25.00 per square foot[11] The estimated construction costs

[4] "Standard Procedure for Analysis and Abatement of Highway Traffic Noise", Ohio Department of Transportation, June 7, 2011, Page 7 of 44.
[5] Ibid, page 8 of 44.
[6] Ibid.
[7] Ibid.
[8] Ibid.
[9] Ibid.
[10] Ibid.
[11] Ibid, Page 10 of 44.

for a noise barrier mounted on a bridge structure is based on unit cost of $50.00 per square foot.[12]

"Barriers shall be designed with the noise reduction design goal of at least 7 dB(A) for at least one benefited receptor."[13] "

"For abatement to be designed and constructed, a minimum of 50% of the benefited property owners and residences should respond in favor of abatement."[14]

Based on ODOT's policy for determining feasibility and reasonability of noise barriers, all four of the modeled noise barriers are feasible, and three of the four are reasonable. The following breakdown provides specific information for each of the noise barriers examined. Additionally, more detailed information regarding these noise barriers can be found in Appendix E.

- Noise Barrier 1 – South side of the Opportunity Corridor mainline between Kinsman Road and the east end of the bridge over the GCRTA Blue and Green Line tracks (See Figure A2, Appendix A).
  - Length of NB – 732 ft.
  - Height Range of NB – 7.5' to 8' sections
  - Square Footage – 4,268 sq. ft.
  - Noise Barrier Cost - $146,500
  - Benefited Receptors – 4 – N21 (2 dwelling units) and N22 (2 dwelling units)
  - Cost per Receptor – $36,625
  - This noise barrier is feasible. However, it is not reasonable as the cost exceeds ODOT's criteria of $35,000 per benefited receptor.

- Noise Barrier 2 – South side of the Opportunity Corridor mainline between 71st Place and 75th Street (See Figure A2, Appendix A).
  - Length of NB – 609 ft.
  - Height Range of NB – 11' to 14' sections
  - Square Footage – 7,580 sq. ft.
  - Noise Barrier Cost – $189,500
  - Benefited Receptors – 6 – N24 (3 dwelling units), N27 (2 dwelling units), and N28 (1 dwelling unit), in addition the noise levels for N25 (1 dwelling unit), N26 (1 dwelling unit), N29 (1 dwelling unit), N30 (1 dwelling unit), and N31 (1 dwelling unit) would be reduced such that the substantial increase impact would be mitigated.
  - Cost per Receptor – $31,583
  - This noise barrier is both feasible and reasonable.

- Noise Barrier 3 – North side of the Opportunity Corridor mainline between the eastern edge of the bridge over the GCRTA Blue and Green Line tracks and 75th Street (See Figure A2, Appendix A).

[12] Noel Alcala, Noise barrier review conference call, ODOT, October 19, 2012.
[13] Ohio Department of Transportation, Page 8 of 44.
[14] Ibid.

- Length of NB – 540 ft.
- Height Range of NB – 13' sections
- Square Footage – 7,020 sq. ft.
- Noise Barrier Cost – $175,500
- Benefited Receptors – 7 – N34 (2 dwelling units), N35 (4 dwelling units), and N36 (1 dwelling unit)
- Cost per Receptor – $25,071
- This noise barrier is both feasible and reasonable.

- Noise Barrier 4 – North side of the Opportunity Corridor mainline between Evins Avenue and Buckeye Road (See Figure A4, Appendix A).
  - Length of NB – 500 ft.
  - Height Range of NB – 13' sections
  - Square Footage – 6,497 sq. ft.
  - Noise Barrier Cost – $162,425
  - Benefited Receptors – 15 – (N50 (4 dwelling units), N51 (2 dwelling units), N53 (2 dwelling units), and N54 (7 dwelling units)
  - Cost per Receptor – $10,828
  - This noise barrier is both feasible and reasonable.

There are seven additional receptors along the Opportunity Corridor for which noise mitigation was not feasible. FS-12 and N38 will have access to the Opportunity Corridor. Therefore a continuous noise barrier cannot be constructed that would provide a 5 decibel noise reduction. Receptors N18 and N41 are adjacent to the boulevard at side road intersections and walls cannot be constructed in such a manner to shield the receptor to provide a 5 decibel reduction. Receptors N70, N72, and N74 are adjacent to the sidewalk along East 105th Street preventing the construction of a noise barrier.

7.0 UNDEVELOPED LANDS

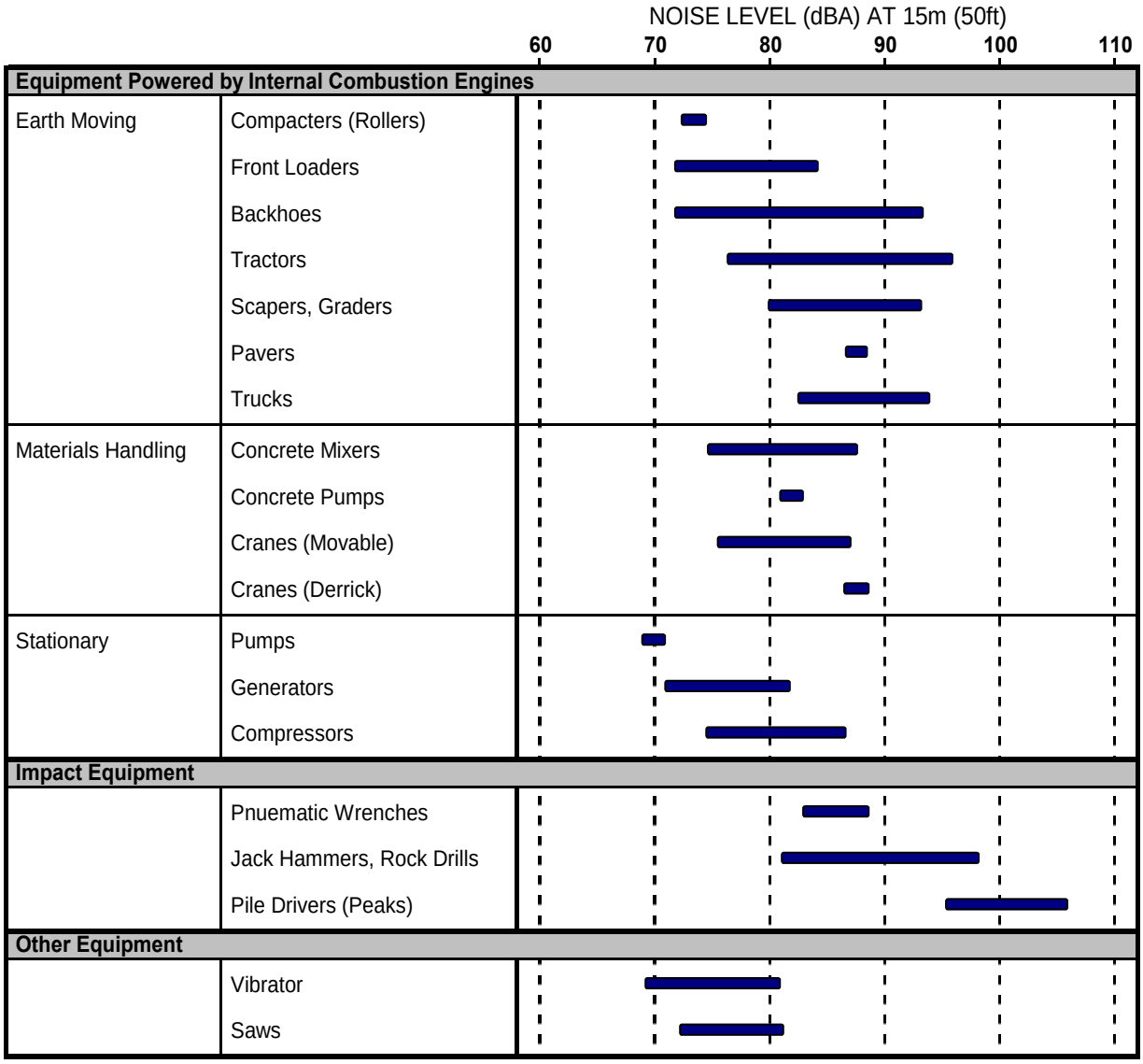
The distances to 66 dB(A) L_{eq}(1h), which vary along the project corridor, were developed to assist local planning authorities in developing land use control over the remaining undeveloped lands along the project in order to prevent further development of incompatible land use. Undeveloped areas exist along both sides off the proposed mainline and along portions of East 105th Street. Along the proposed mainline, the distance to 66 dBA Leq(h) would range from 50 to 100 ft. from the edge of the pavement. Along East 105th Street, the distance to 66 dBA Leq(h) varies between 25 to 50 ft. The distance indicates that noise levels within the distance presented listed, measured perpendicular to the nearest edge of pavement is 66 dBA or greater. The distance to 71 dB(A) L_{eq}(1h) occurs within the right-of-way, Given the variation in cross sections and elevations adjacent to the project, it is recommended that any future residential development proposed in the area of the project be modeled with accurate survey data to avoid creating incompatible land uses adjacent the project.

8.0 CONSTRUCTION NOISE

The major construction elements of this project are expected to be demolition, hauling, grading, paving, and bridge construction. Construction of the proposed improvements will result in a temporary increase in the ambient noise level along the Opportunity

Corridor. General construction noise impacts for passerby and those individuals living or working near the project can be expected particularly from demolition, earth moving, pile driving, and paving operations. Equipment associated with construction generally includes backhoes, graders, pavers, concrete trucks, compressors, and other miscellaneous heavy equipment. Table 5 lists some typical peak operating noise levels at a distance of 15 m (50 feet), grouping construction equipment according to mobility and operating characteristics. Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

Table 5: Construction Equipment Sound Levels



SOURCE: U.S. Report to the President and Congress on Noise, February, 1972.

9.0 CONCLUSION

ODOT's policy is to install feasible and reasonable noise barriers associated with transportation improvements. Table 6 summarizes the three noise barriers that are feasible and reasonable for this project. The locations of the noise barriers can be found in Appendix A. Based on the study completed, mitigation of noise impacts for the proposed Opportunity Corridor project appears to be feasible and reasonable for Noise Barriers 2, 3 and 4. These barriers are located along the proposed Opportunity Corridor mainline and are designed to mitigate the noise impact for adjacent residences. There remain 10 receptors along the Opportunity Corridor for which noise mitigation was not feasible or in the case of the receptors adjacent to Noise Barrier 1, not reasonable. The final decision on the construction of the noise barriers will take place during final design and upon completion of the public involvement process. If it is determined during final design that conditions have substantially changed, the abatement measures may need to be reassessed.

Table 6: Feasible and Reasonable Noise Barriers

Noise Barrier ID	Noise Barrier Location	TNM Modeled		Noise Barrier Cost[1]	Number of Benefited Receptors (Dwelling Units)	Cost Per Benefited Receptor[2]
		Length (ft)	Area (sq ft)			
NB-2	South side of the Opportunity Corridor mainline between 71st Place and 75th Street	609	7,580	$189,500	6	$31,583
NB-3	North side of the Opportunity Corridor mainline between the eastern edge of the bridge over the GCRTA Blue and Green Line tracks and 75th Street	540	7,020	$175,500	7	$25,071
NB-4	North side of the Opportunity Corridor mainline between Evins Avenue and Buckeye Road	500	6,497	$162,425	15	$10,828

[1] Based on $25.00 per square foot.
[2] 'Reasonable Cost per Dwelling Unit' is less than or equal to $35,000 per benefited receptor.

10.0 REFERENCES

Alcala, Noel, Noise barrier review Conference Call, ODOT, October 19, 2012.

Anderson, G. S., C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

Lau, Michael C., Cynthia S. Y. Lee, Gregg G. Judith L. Rochat, Eric R. Boeker, and Gregg C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004.

"Standard Procedure for Analysis and Abatement of Highway Traffic Noise", Standard Procedure 417-001(SP), Ohio Department of Transportation's, June 7, 2011.

APPENDIX A
Noise Receiver Locations and Proposed Noise Barriers

Legend

- FS-9 — Field Measurement Site
- N12 — Noise Modeling Site
- Impacted Receptors
- Benefited Receptor
- Feasible and Reasonable Noise Barrier
- Feasible but Not Reasonable Noise Barrier
- Structure to be Acquired

N

0 100 200 400

Feet

1 inch = 200 feet

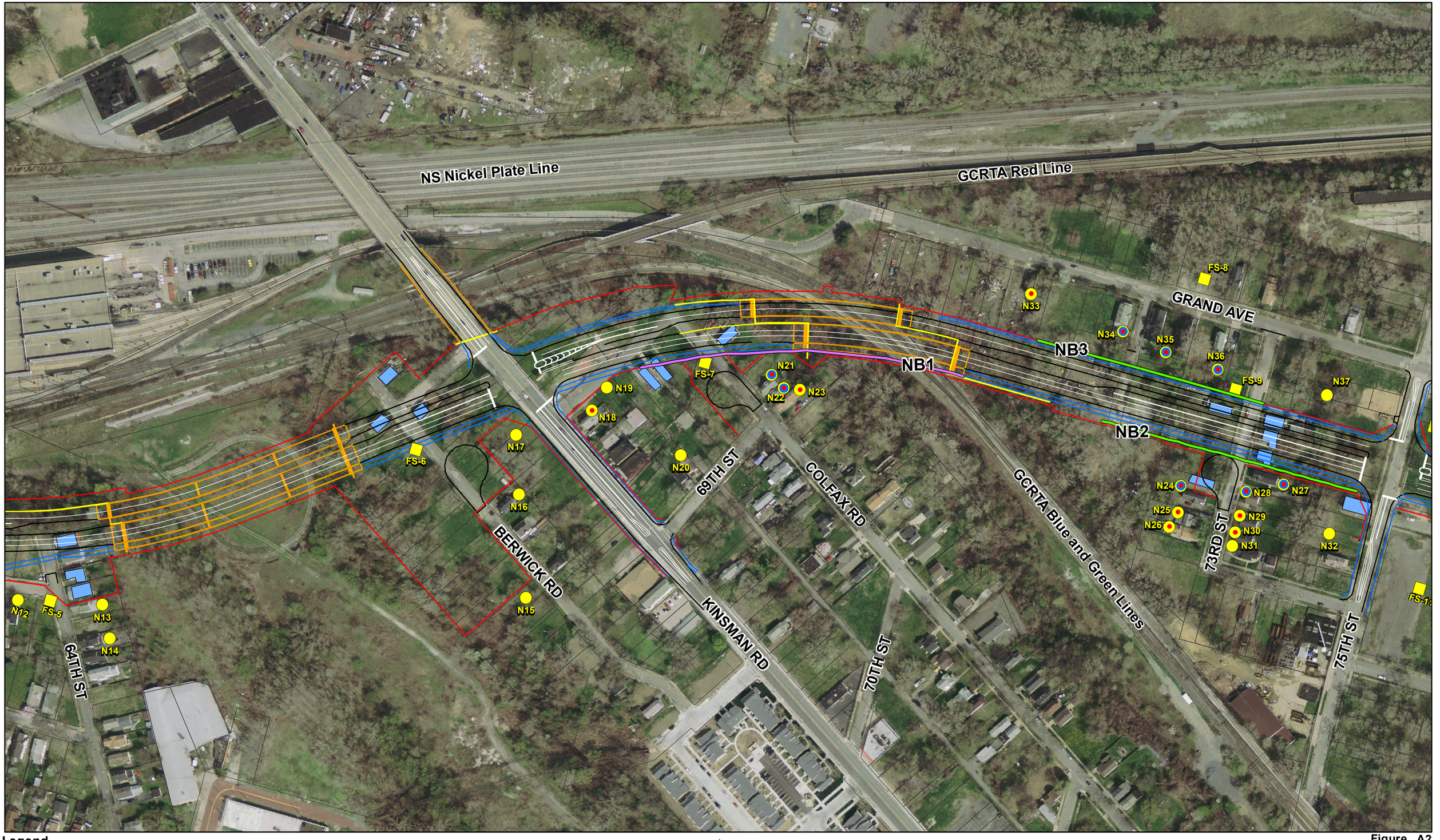
Figure A1

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio



Legend

- FS-9 — Field Measurement Site
- N12 — Noise Modeling Site
- Impacted Receptors
- Benefited Receptor
- Feasible and Reasonable Noise Barrier
- Feasible but Not Reasonable Noise Barrier
- Structure to be Acquired

N

0 100 200 400
Feet

1 inch = 200 feet

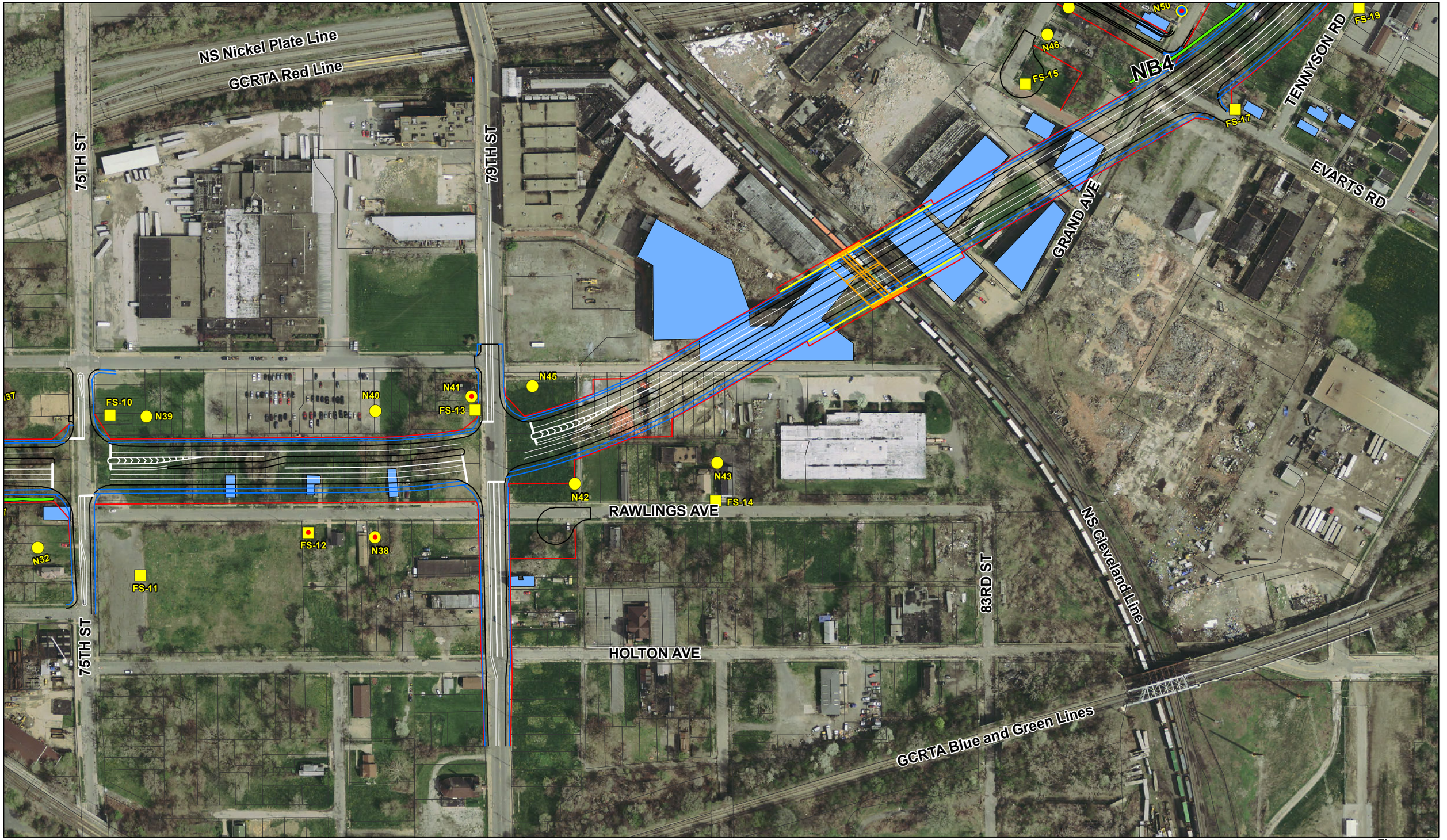
Figure A2

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio



Legend

FS-9 Field Measurement Site

N12 Noise Modeling Site

Impacted Receptors

Benefited Receptor

Feasible and Reasonable Noise Barrier

Feasible but Not Reasonable Noise Barrier

Structure to be Acquired

N

0 100 200 400

Feet

1 inch = 200 feet

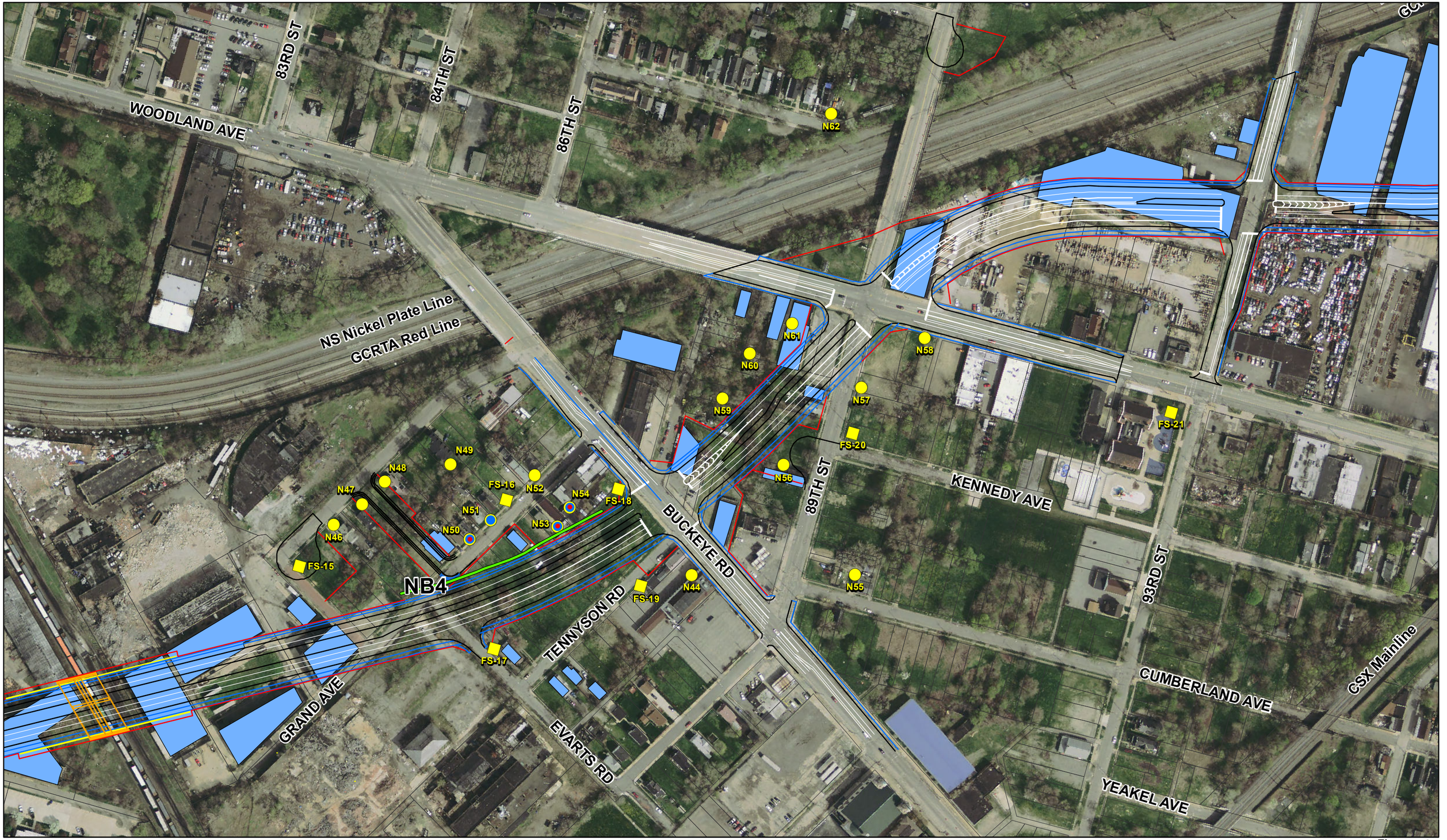
Figure A3

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio



Legend

- FS-9 — Field Measurement Site
- N12 — Noise Modeling Site
- Impacted Receptors
- Benefited Receptor
- Feasible and Reasonable Noise Barrier
- Feasible but Not Reasonable Noise Barrier
- Structure to be Acquired

N

0 100 200 400
Feet

1 inch = 200 feet

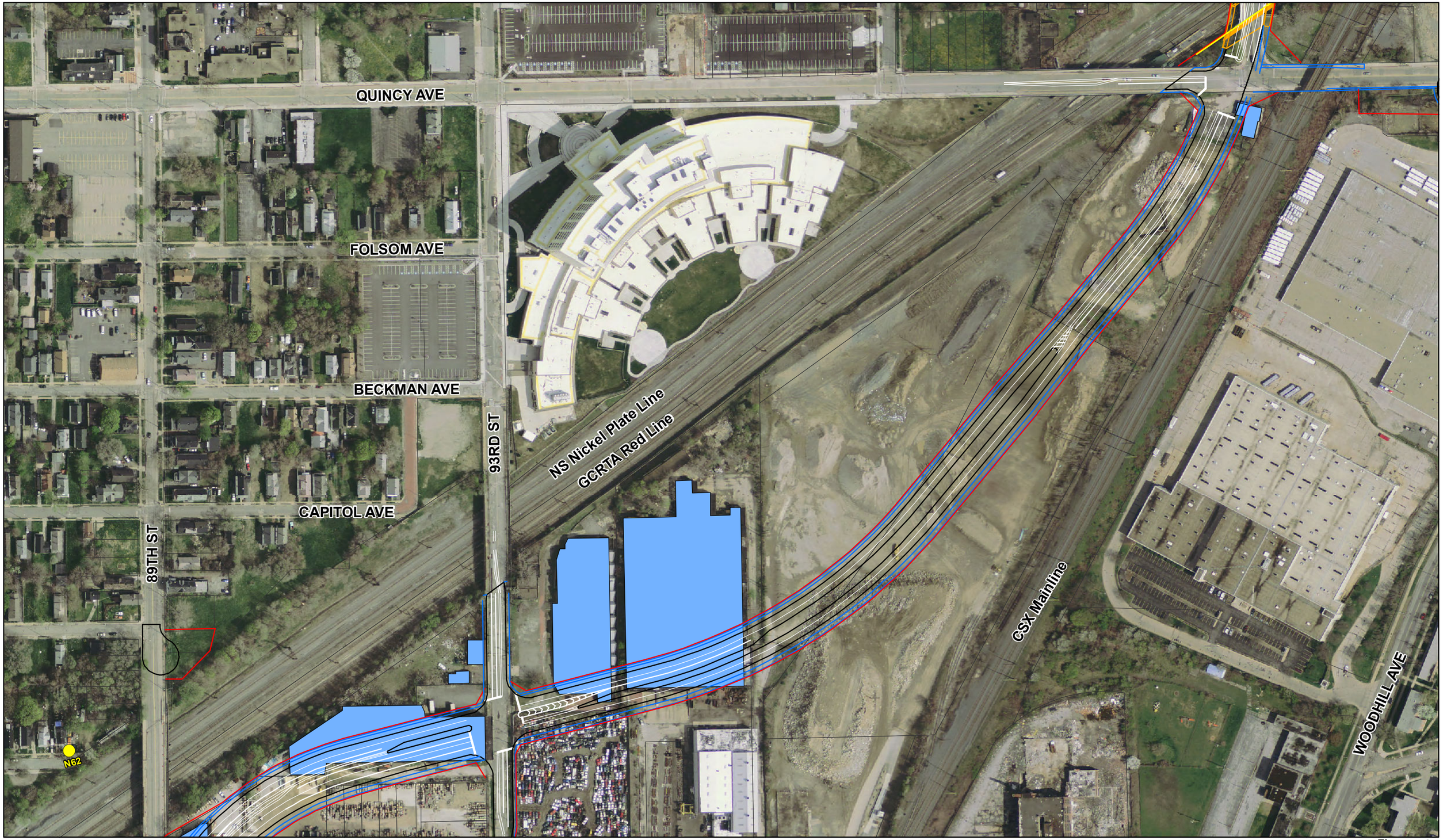
Figure A4

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio



Legend

FS-9 Field Measurement Site

N12 Noise Modeling Site

Impacted Receptors

Benefited Receptor

Feasible and Reasonable Noise Barrier

Feasible but Not Reasonable Noise Barrier

Structure to be Acquired

N

0 100 200 400

Feet

1 inch = 200 feet

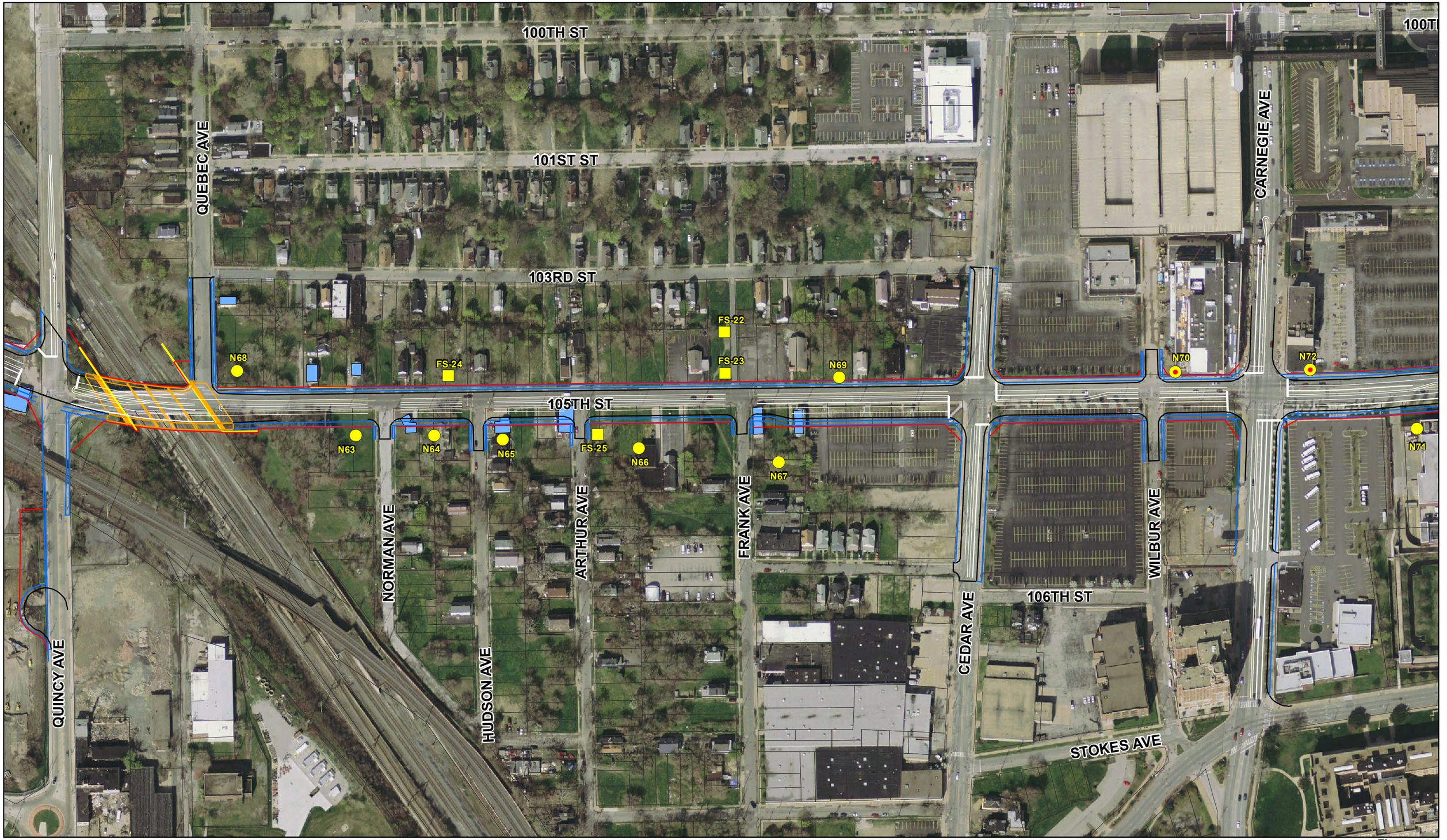
Figure A5

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio



Legend

- FS-9 — Field Measurement Site
- N12 — Noise Modeling Site
- Impacted Receptors
- Benefited Receptor
- Feasible and Reasonable Noise Barrier
- Feasible but Not Reasonable Noise Barrier
- Structure to be Acquired

N

0 100 200 400
Feet

1 inch = 200 feet

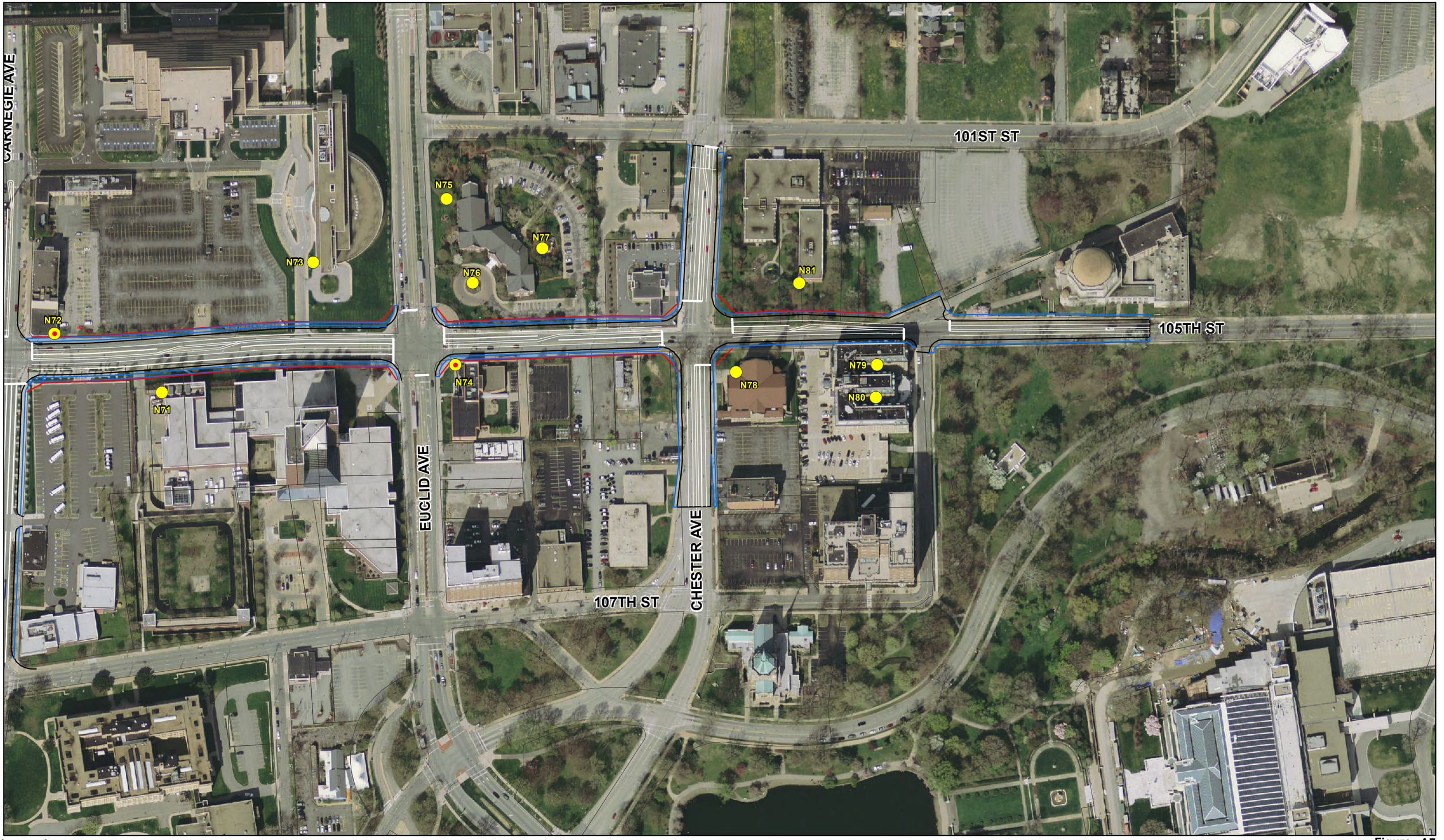
Figure A6

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio



Legend

- FS-9 — Field Measurement Site
- N12 — Noise Modeling Site
- Impacted Receptors
- Benefited Receptor
- Feasible and Reasonable Noise Barrier
- Feasible but Not Reasonable Noise Barrier
- Structure to be Acquired

N

0 100 200 400
Feet

1 inch = 200 feet

Figure A7

NOISE ANALYSIS

Preferred Alternative

Opportunity Corridor

Cleveland, Ohio

APPENDIX B
Field Measurement Data Sheets

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: 57th & Bower FS-1 DATE: 11-18-10 TIME: 15:49:22

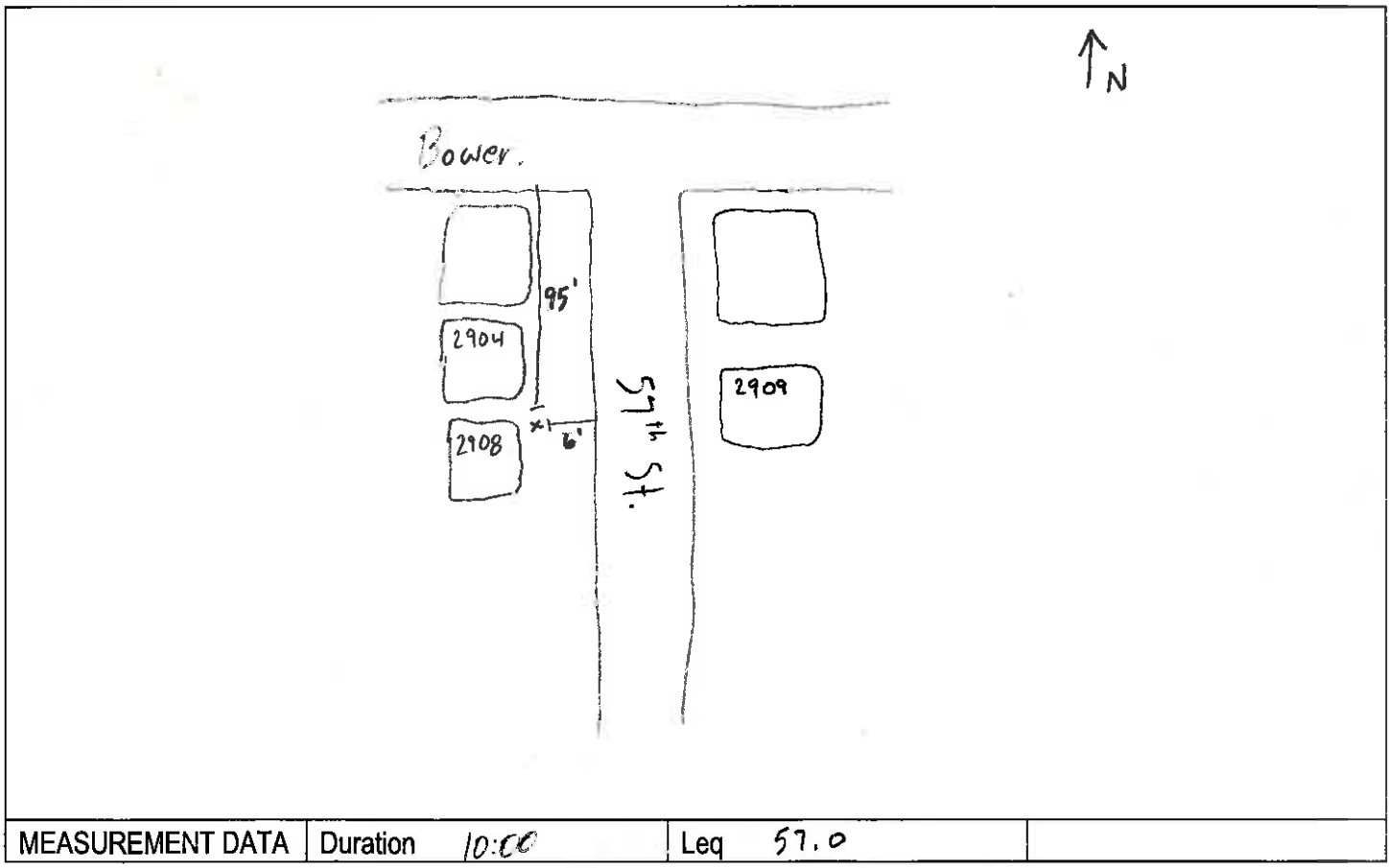
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	5	
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10:00	Leq 57.0	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER Partly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JKJ

SITE: FS-2 DATE: 11-18-10 TIME: 17:10

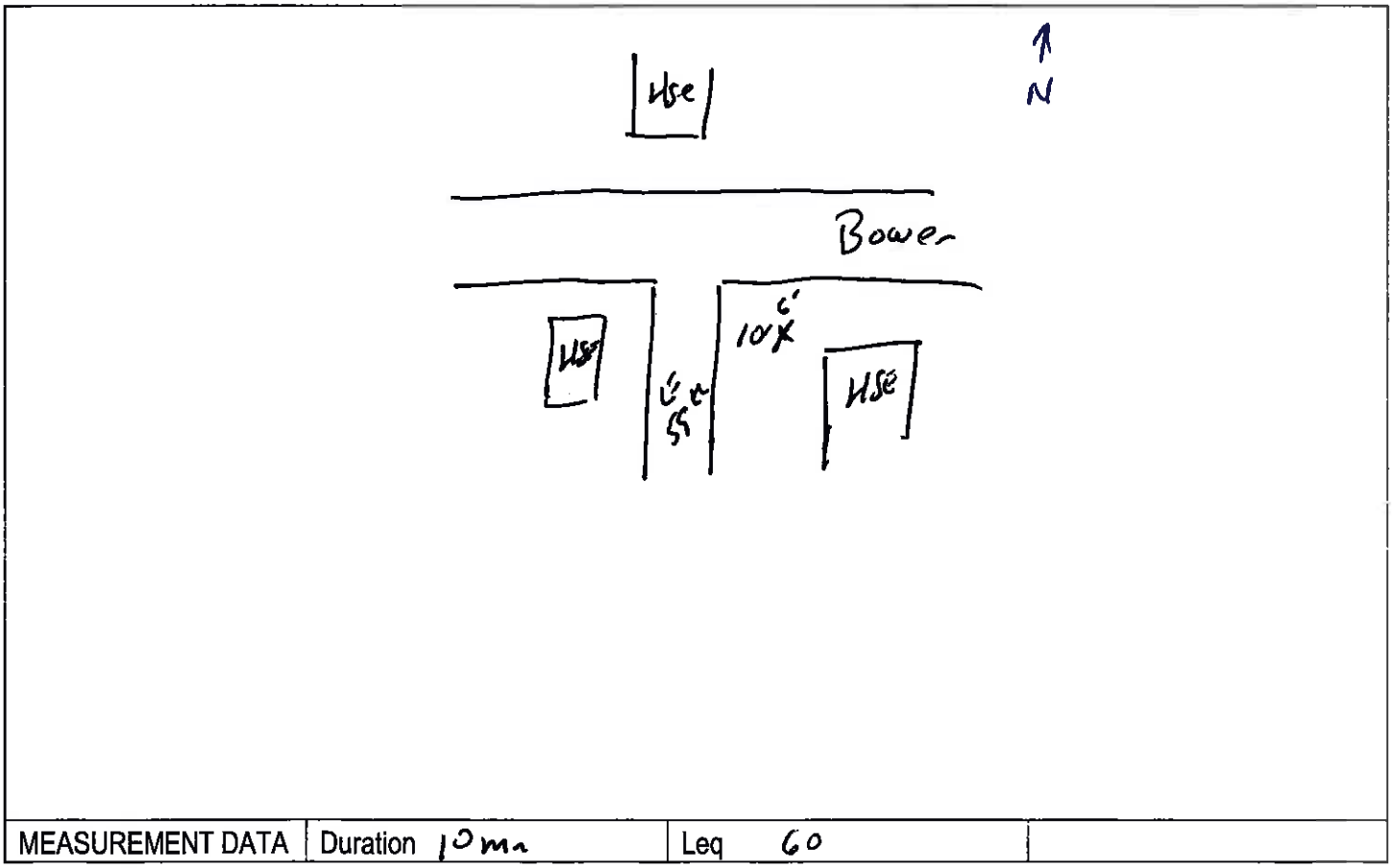
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10 ma	Leq 60	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER Partly Cloudy

BACKGROUND NOISE

MAJOR SOURCES I-490 on RAMP 55' @ 55

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-3 DATE: 11-18-10 TIME: 10:58 - Chase Fashion

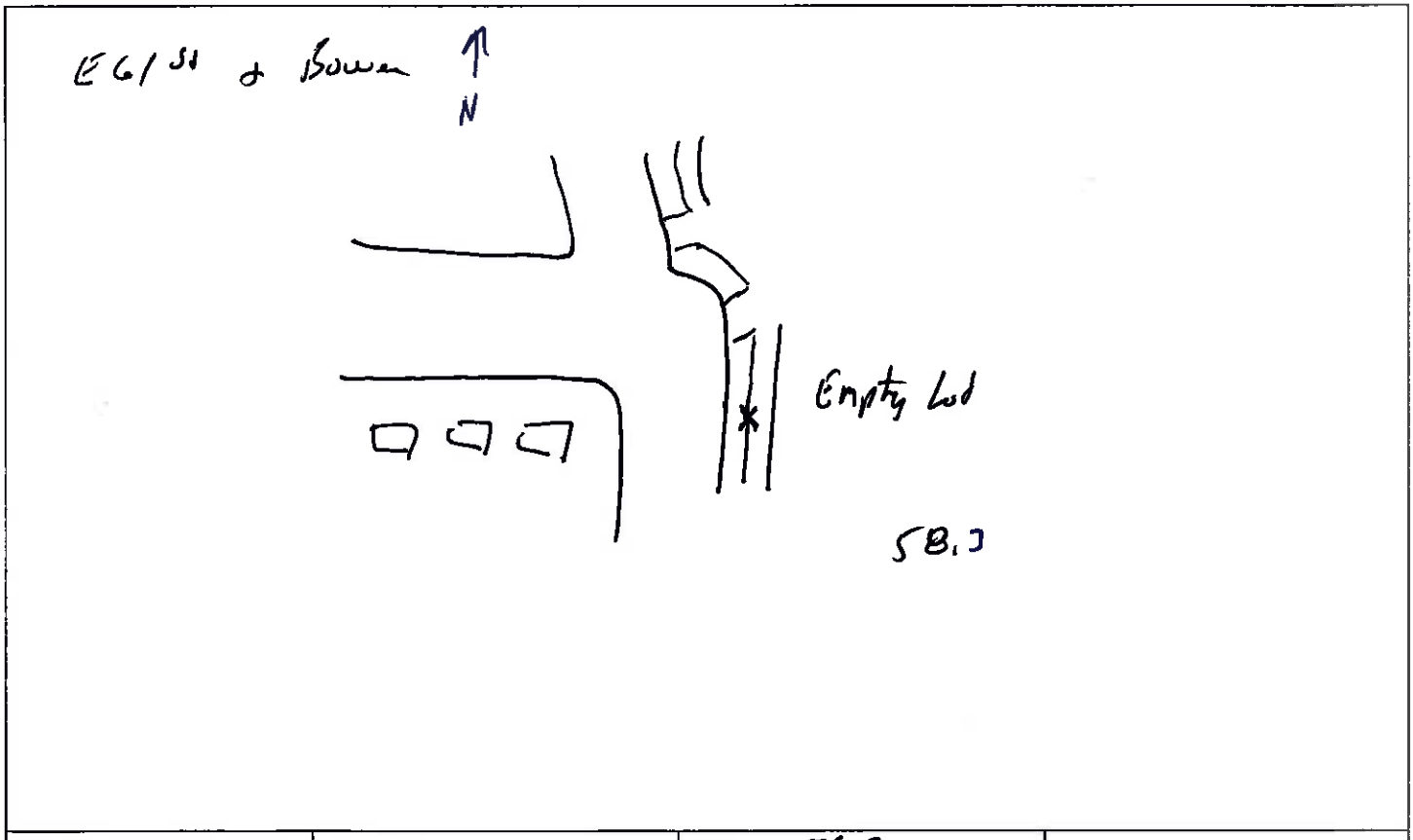
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10 min	Leq 58.3	

WEATHER DATA WIND SPEED (MPH) 8-11 DIR. W TEMP. 45 HUMIDITY 74% CLOUD COVER 100%

BACKGROUND NOISE Distant Traffic

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-4 DATE: 11-18-10 TIME: 16:52

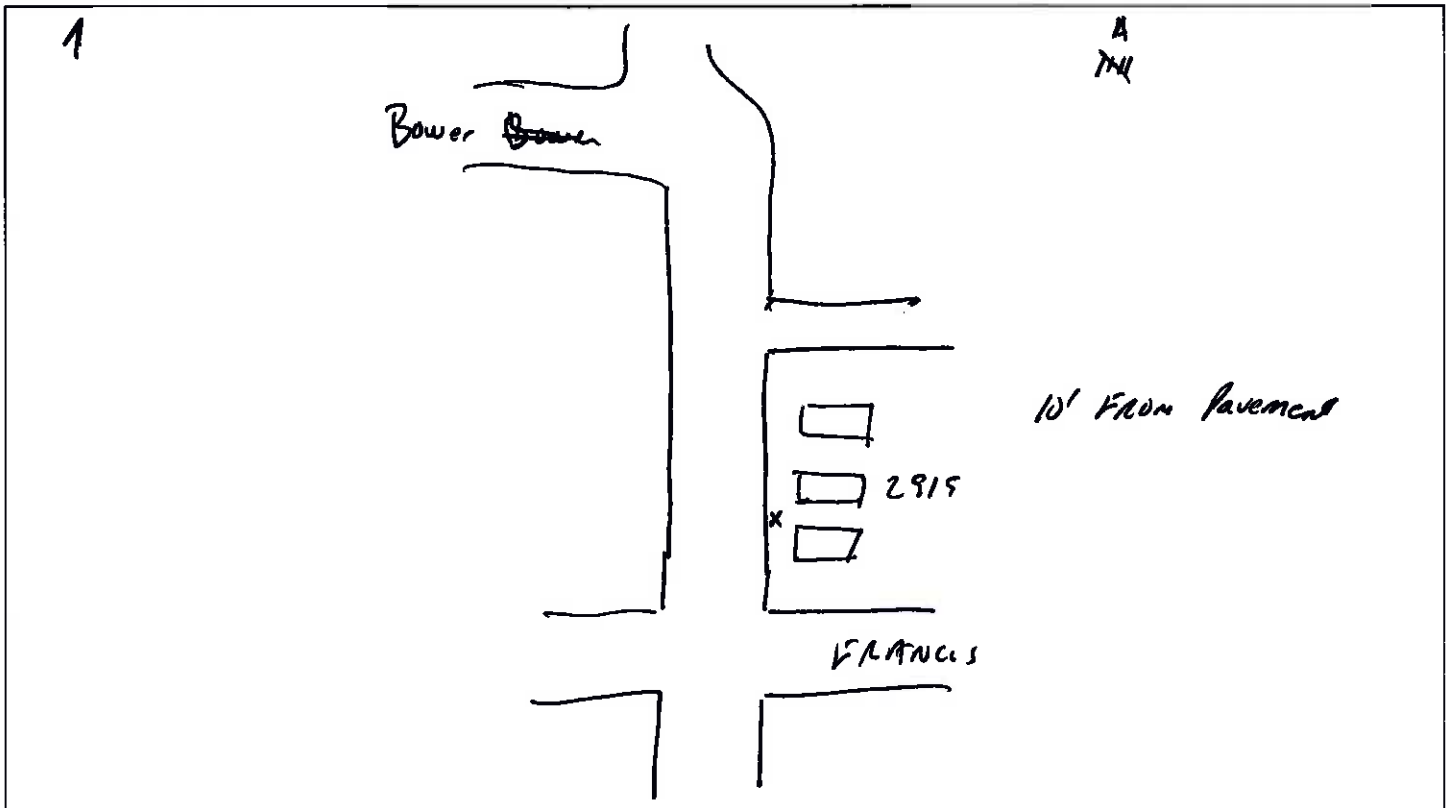
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	5	
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10 min	Leq 57.1	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER 95%

BACKGROUND NOISE 55% Interstate Planes are Traffic noise

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: Butler & 64th FS-5 DATE: 11-18-10 TIME: 9:53:00

CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

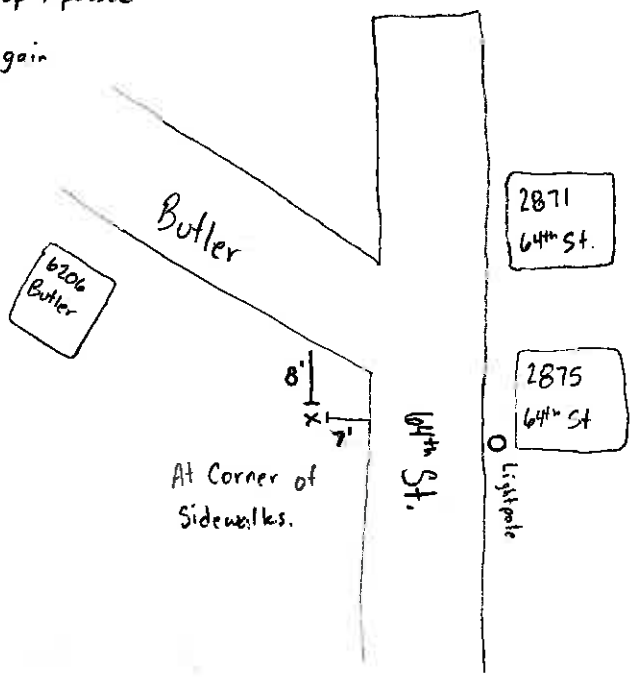
TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	2	
MED TRKS	0	
HVY TRKS	0	
BUS	0	
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH

5:55 - mail truck started up & passed

7:00 - mail truck passed again



Removed mail trucks)

Leq = 57.2

MEASUREMENT DATA	Duration 10:00	Leq 57.7	

WEATHER DATA WIND SPEED (MPH) 8-11 DIR. W TEMP. 45 HUMIDITY 74% CLOUD COVER Mostly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: Berwick & 66th FS-6 DATE: 11-18-10 TIME: 15:17:00

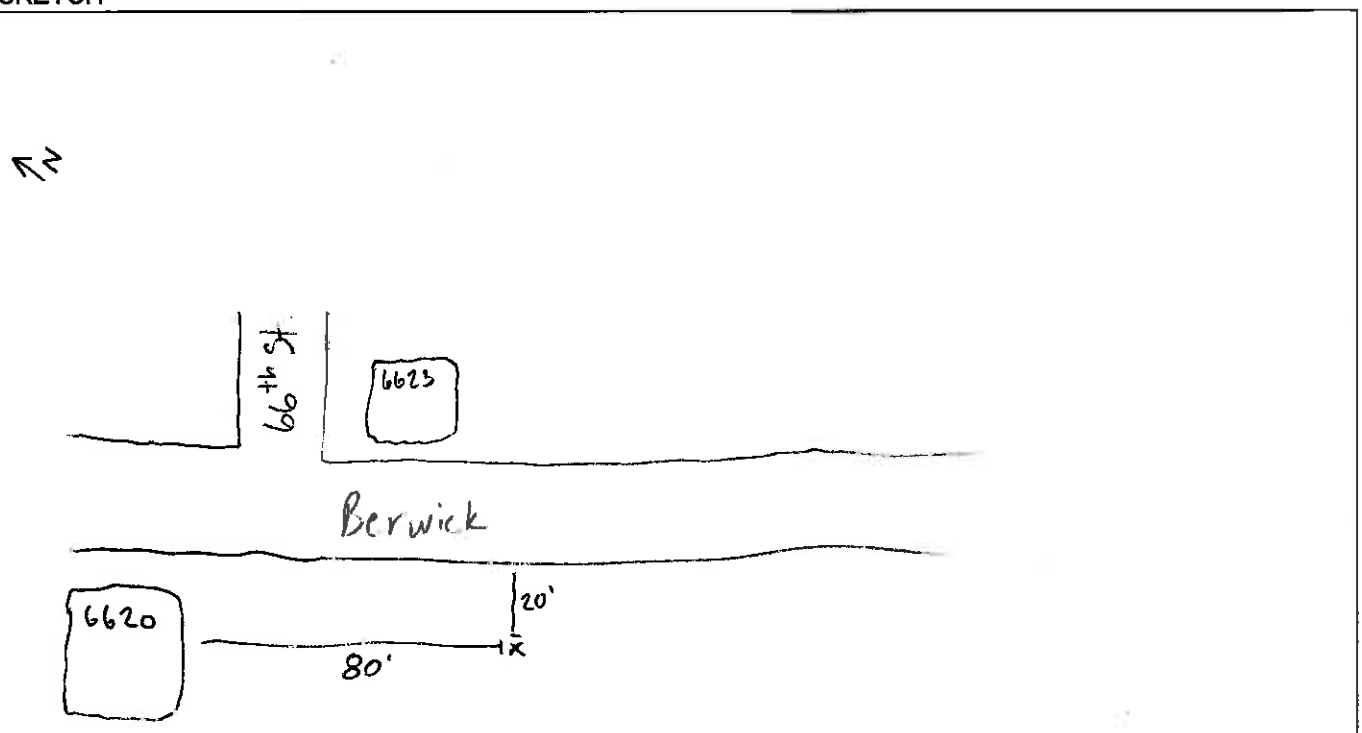
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA (From Kinsman Rd)		
ROAD (Name/Dir)	Berwick	
AUTOS	"	434
MED TRKS		3
HVY TRKS		
BUS		7
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20:00	Leq 57.6	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER Partly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: ES-7 DATE: 11-18-10 TIME: 16:20

CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	6	
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH

A
NL 1

0:08 RTA
:44 "
3:23 "
4:25 "
9:06 "

RTA events removed from data. Leq = 56.3

MEASUREMENT DATA	Duration 10 min	Leq 59.0	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER 50%

BACKGROUND NOISE TRAFFIC ON KINSMAN RAIL TRANSIT

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: Grand & 73rd FS-B DATE: 11-18-10 TIME: 10:25:30 10:35:36

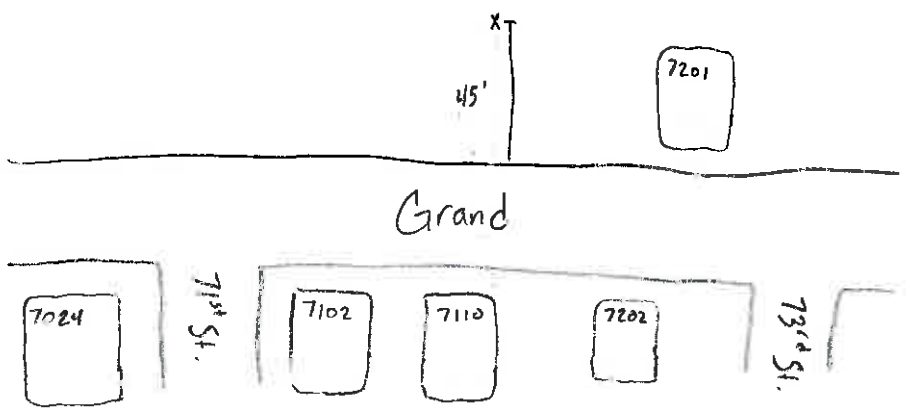
CALIBRATION: 113.8 at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	11	
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



2nd Run

9:20 - Rail Cars Passed

Removed Rail cars

Leq = 53.7

MEASUREMENT DATA	Duration 10:00 (2 runs)	Leq 54.1 + 55.9 =	55.1

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45 HUMIDITY 65% CLOUD COVER Overcast

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: ES-9 DATE: 11-18-10 TIME: 11:25

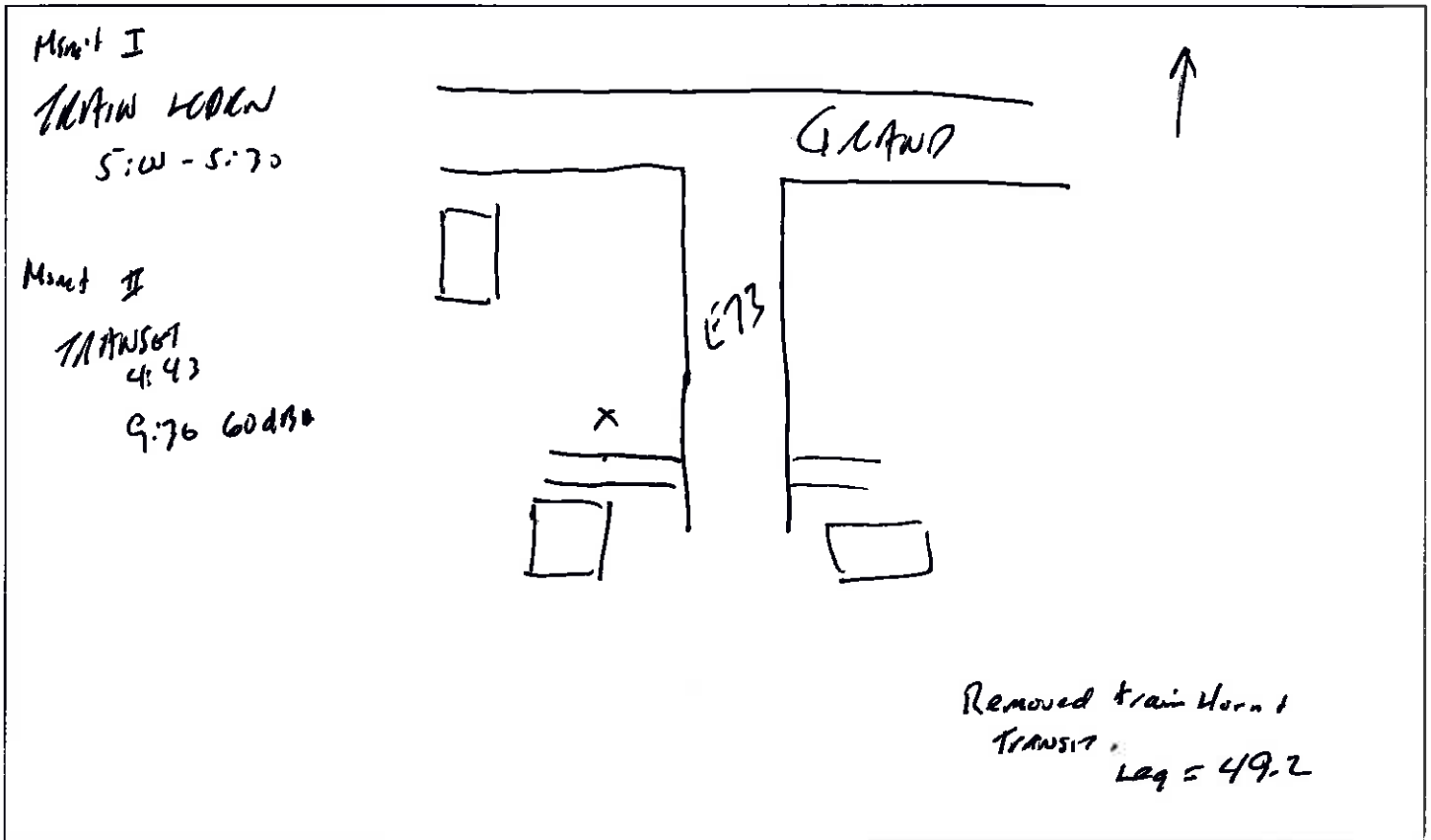
CALIBRATION: 113.8 ~~dBA~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 2-10mn	Leq 51 + 50.8 = 50.9

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45 HUMIDITY 65% CLOUD COVER 100%

BACKGROUND NOISE Distant Traffic - Sirens Intermittent TRAFFIC ON GRADE

~~MAJOR SOURCES~~ Rail TRANSIT to N (4:43) (9:36) 60dBA

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: SEA

SITE: ES-10 DATE: 11-18-10 TIME: 11:53

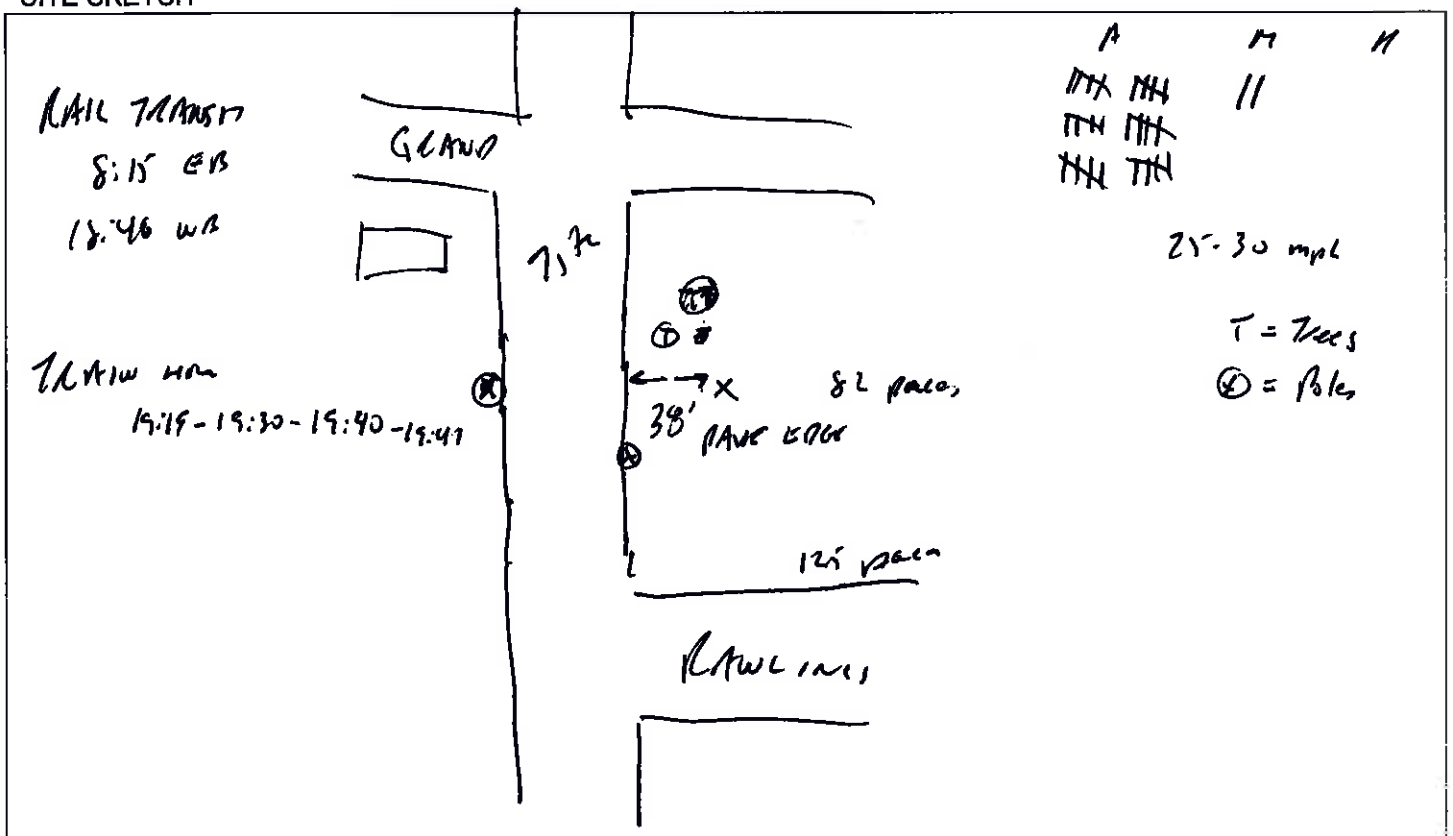
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	73rd Street	
AUTOS	30	
MED TRKS	2	
HVY TRKS	—	
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 56.1	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45° HUMIDITY 65% CLOUD COVER 100%

BACKGROUND NOISE Distant Traffic

MAJOR SOURCES Local Traffic

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: 75th St. & Wagner FS-11 DATE: 11-18-10 TIME: 10:56:00 11:06:10

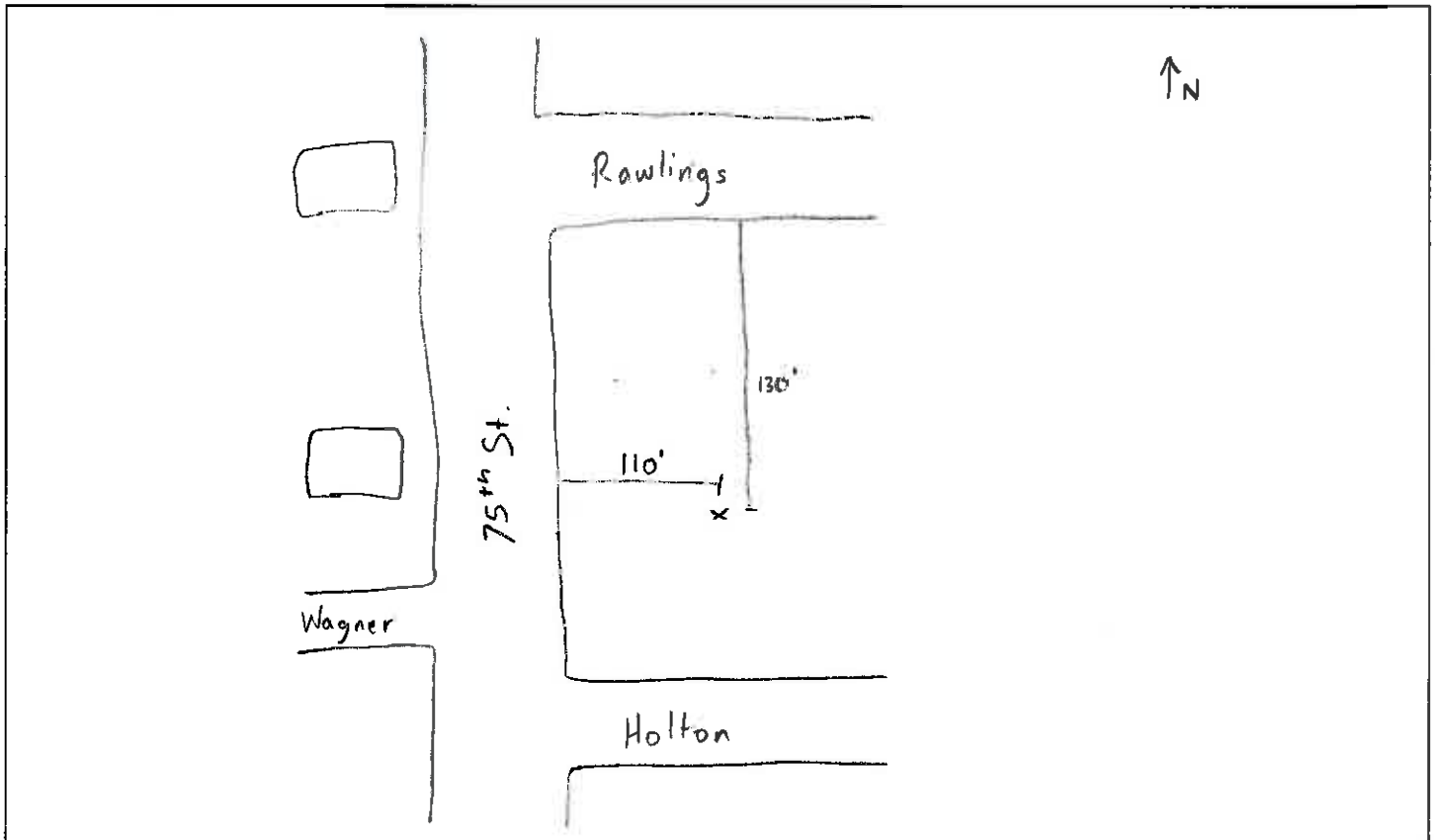
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	33	
MED TRKS		
HVY TRKS		
BUS	1 1	
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10:00 (2 runs)	Leq 53.3 + 53.2 = 53.3

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45 HUMIDITY 65% CLOUD COVER Overcast

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: SEA JKJ

SITE: FS-12 DATE: 11-18-10 TIME: 12:30

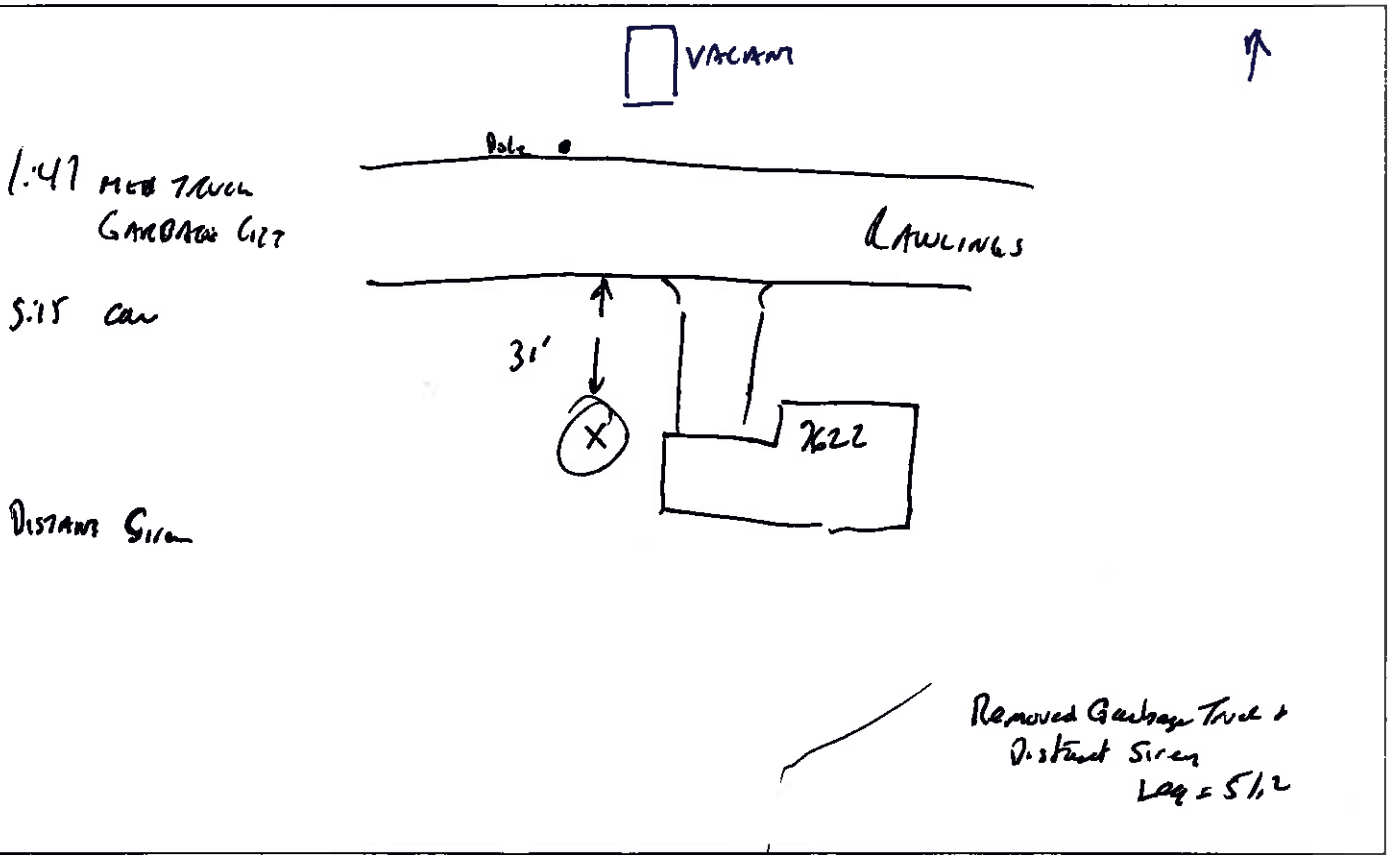
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10 min	Leq 53.3	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45 HUMIDITY 71% CLOUD COVER 95%

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: 79th St F5-13 DATE: 11-18-10 TIME: 11:29.00

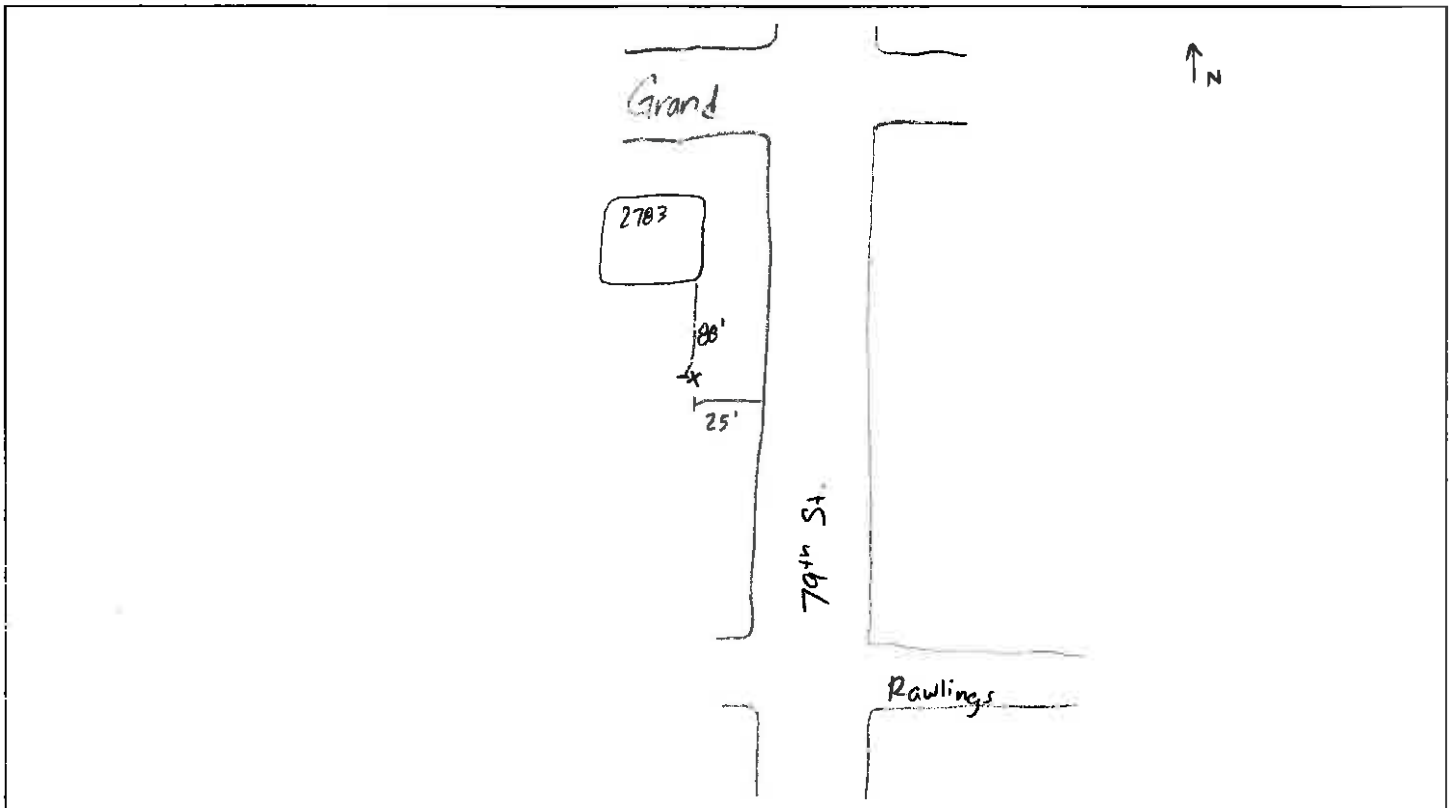
CALIBRATION: 113.8 [redacted] at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	[redacted]	138
AUTOS	[redacted]	
MED TRKS	III	3
HVY TRKS	I	1
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20:00	Leq 63.0	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45 HUMIDITY 71% CLOUD COVER Overcast

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-14 DATE: 11-18-10 TIME: 12:44

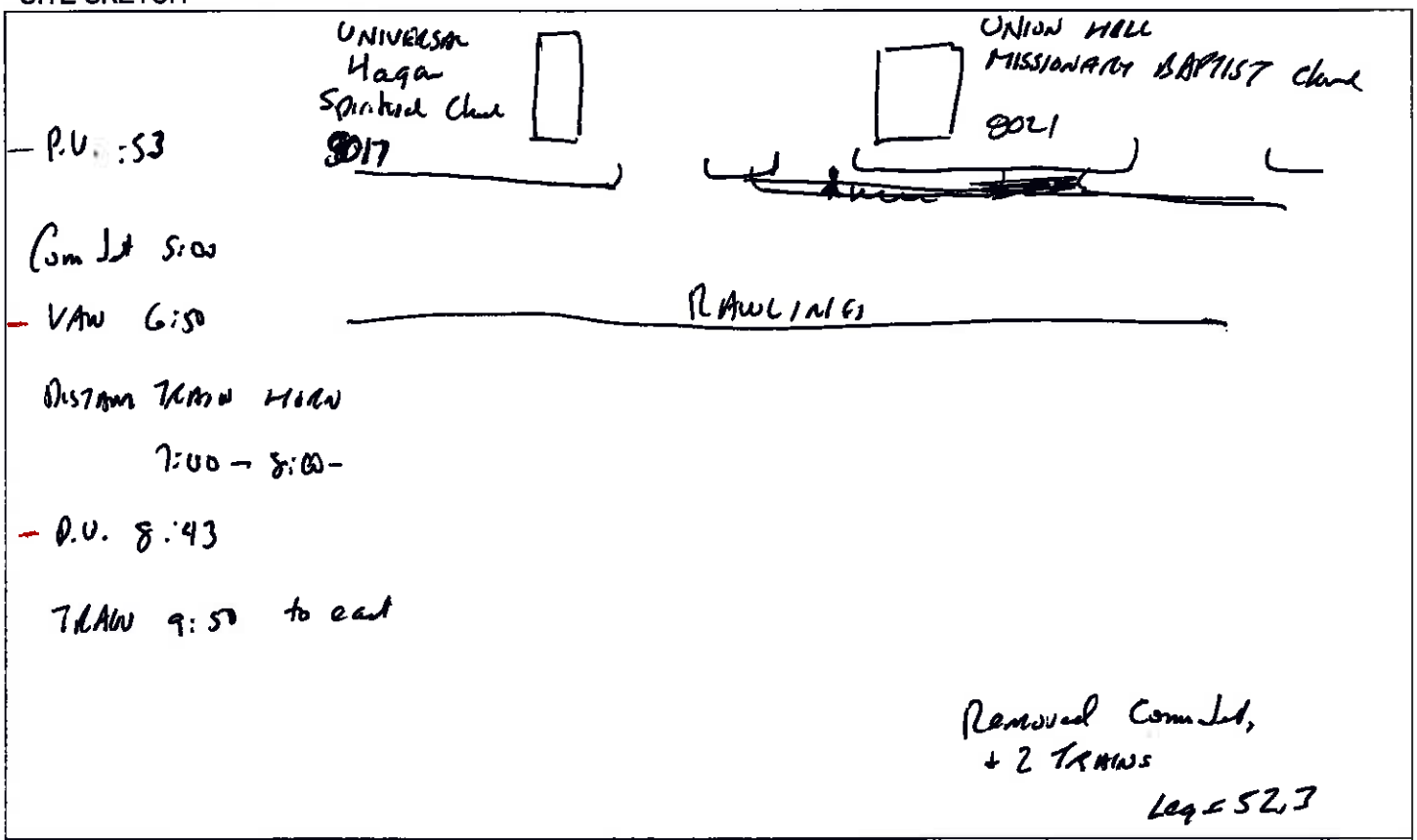
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	3	
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 10:00	Leq 54.7	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 45 HUMIDITY 71% CLOUD COVER 100%

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-15 DATE: 11-18-10 TIME: 13:05

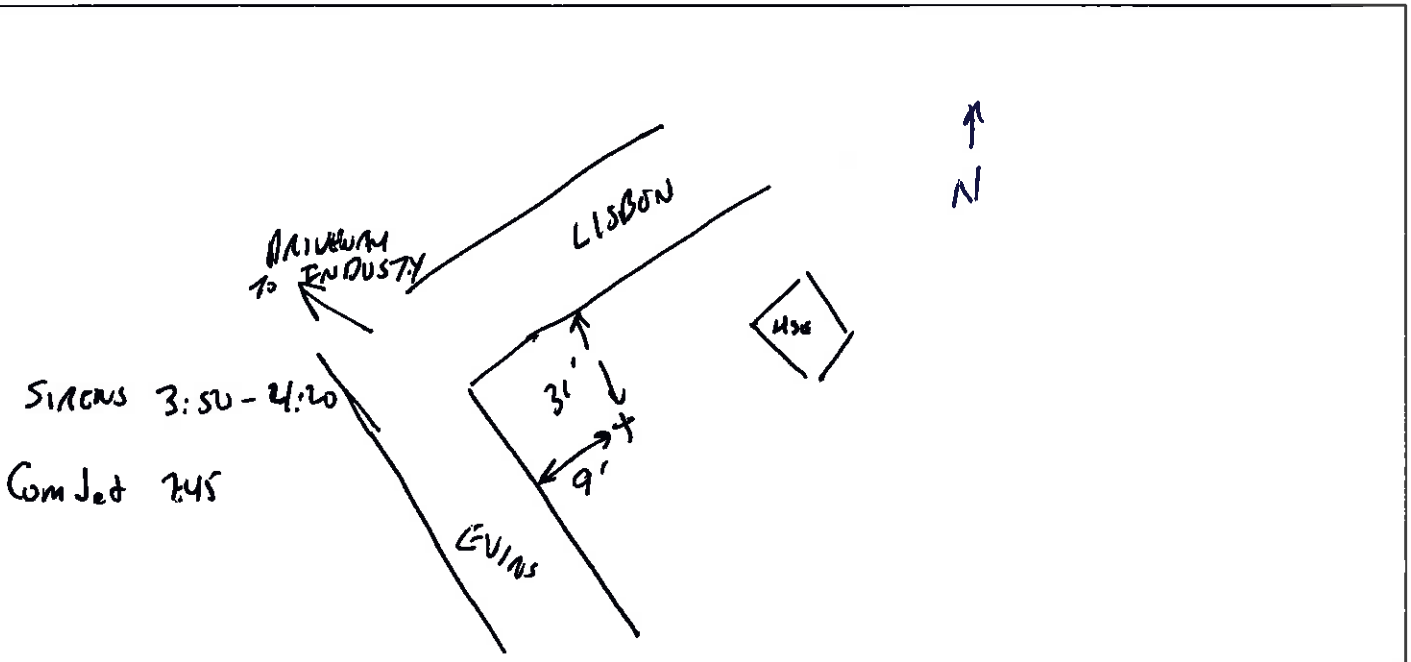
CALIBRATION: 113.8 ~~dB~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



Removed Sirens & Jet
Leq = 56.9

MEASUREMENT DATA	Duration 10:00 min	Leq 57.6	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER 95%

BACKGROUND NOISE Industrial Noises

MAJOR SOURCES "

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: Grand & Buckeye FS-16 DATE: 11-18-10 TIME: 12:21:00

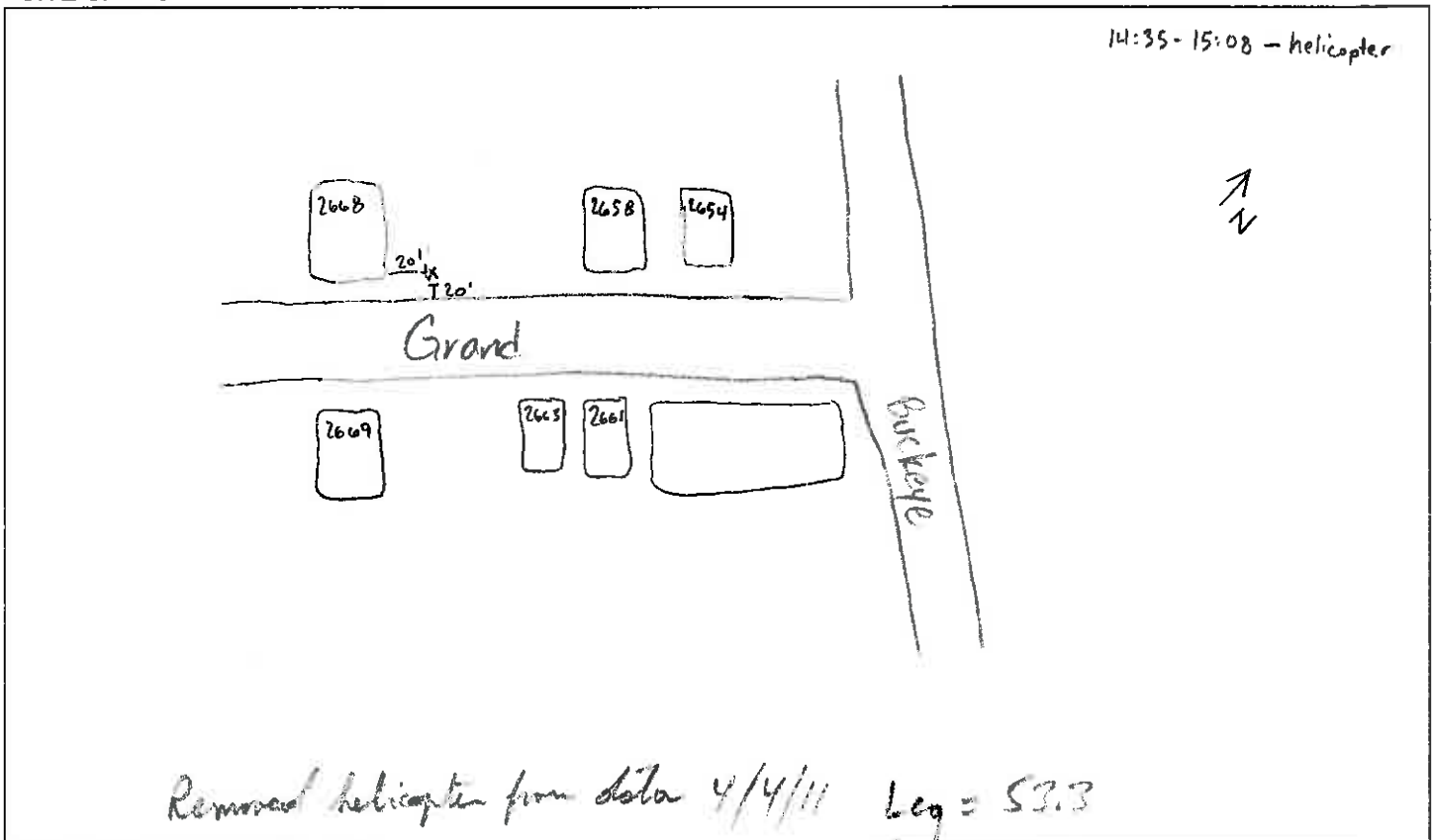
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	5	
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20:00	Leq 55.8	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER Mostly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: Evarts & Grand FS-17 DATE: 11-18-10 TIME: 12:04:30

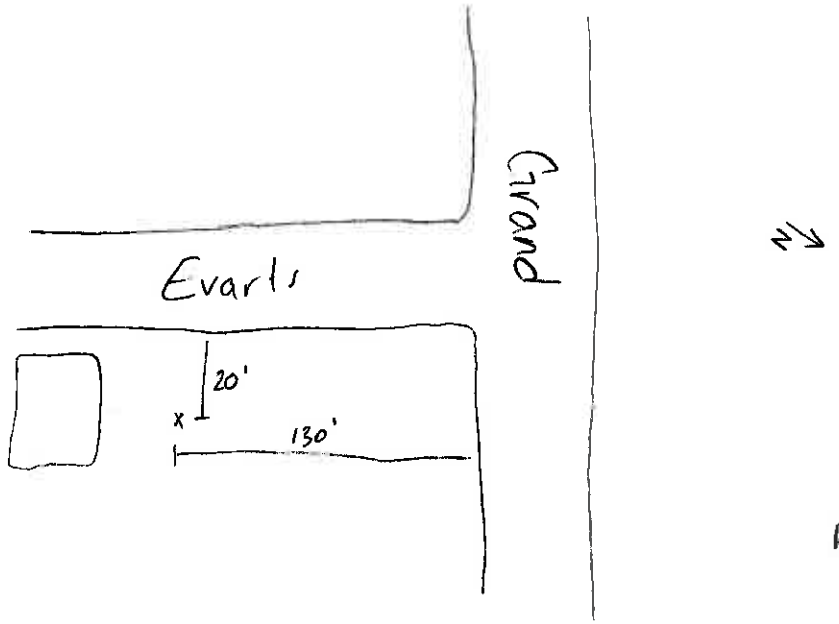
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



Removed Strand Jct. See FS-15

Leq = 51.0

MEASUREMENT DATA	Duration 10:00	Leq 52.5	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER Mostly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-10 DATE: 11-18-10 TIME: 13:22

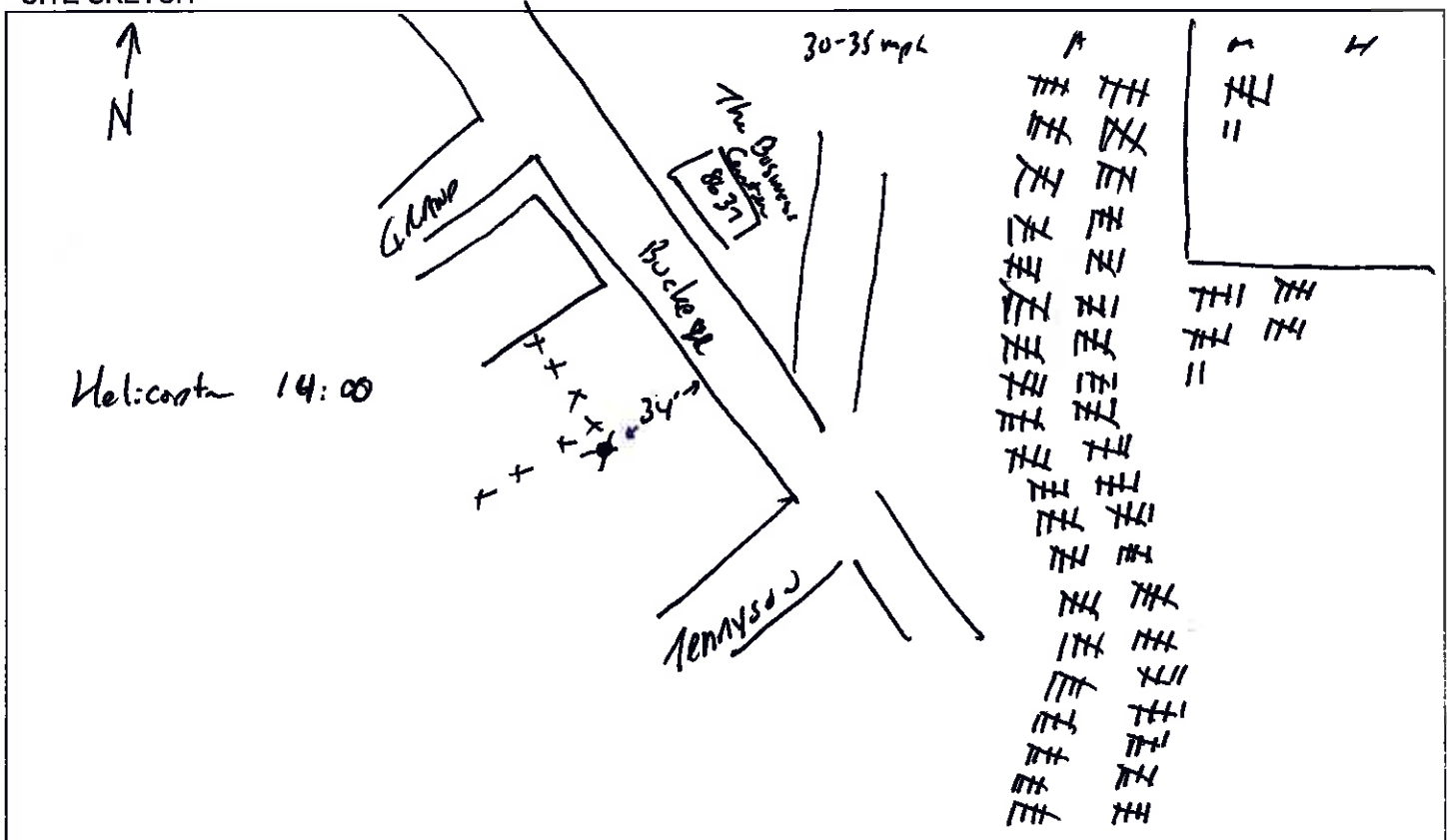
CALIBRATION: 113.8 ~~94~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	222	
MED TRKS	7	
HVY TRKS	—	
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 66.3	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER 95%

BACKGROUND NOISE

MAJOR SOURCES Local Traffic

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: Tennyson @ Buckeye FS-19 DATE: 11-18-10 TIME: 12:52:30

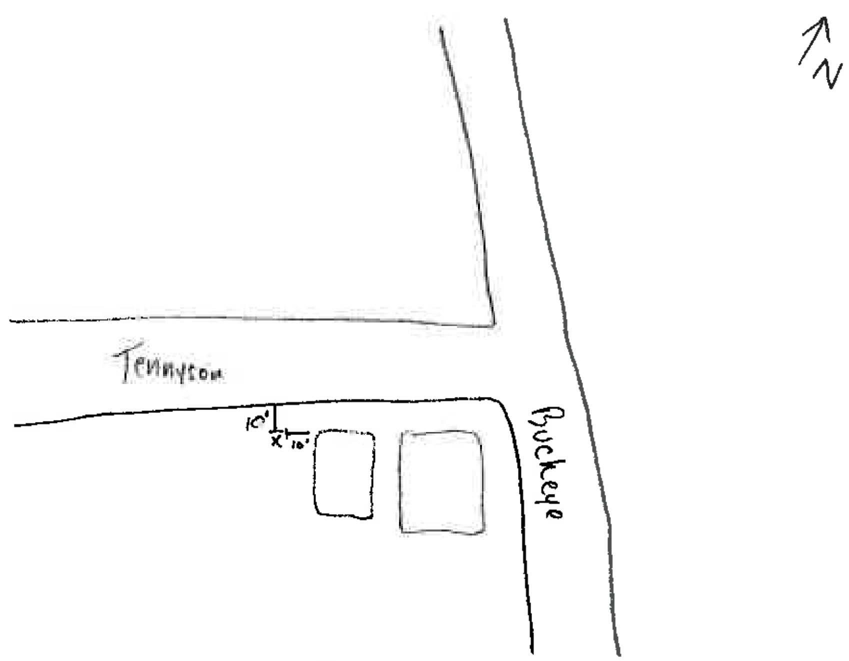
CALIBRATION: 113.8 at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA (From Buckeye Rd)		
ROAD (Name/Dir)		
AUTOS		222
MED TRKS		7
HVY TRKS		0
BUS		0
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA | Duration 2 measurements = 10:00 | Leq 57.3 + 55.9 = 56.7

WEATHER DATA WIND SPEED (MPH) DIR. W TEMP. 44 HUMIDITY 74% CLOUD COVER Mostly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: 89th & Kennedy FS-20 DATE: 11-18-10 TIME: 13:08:30 13:28:45

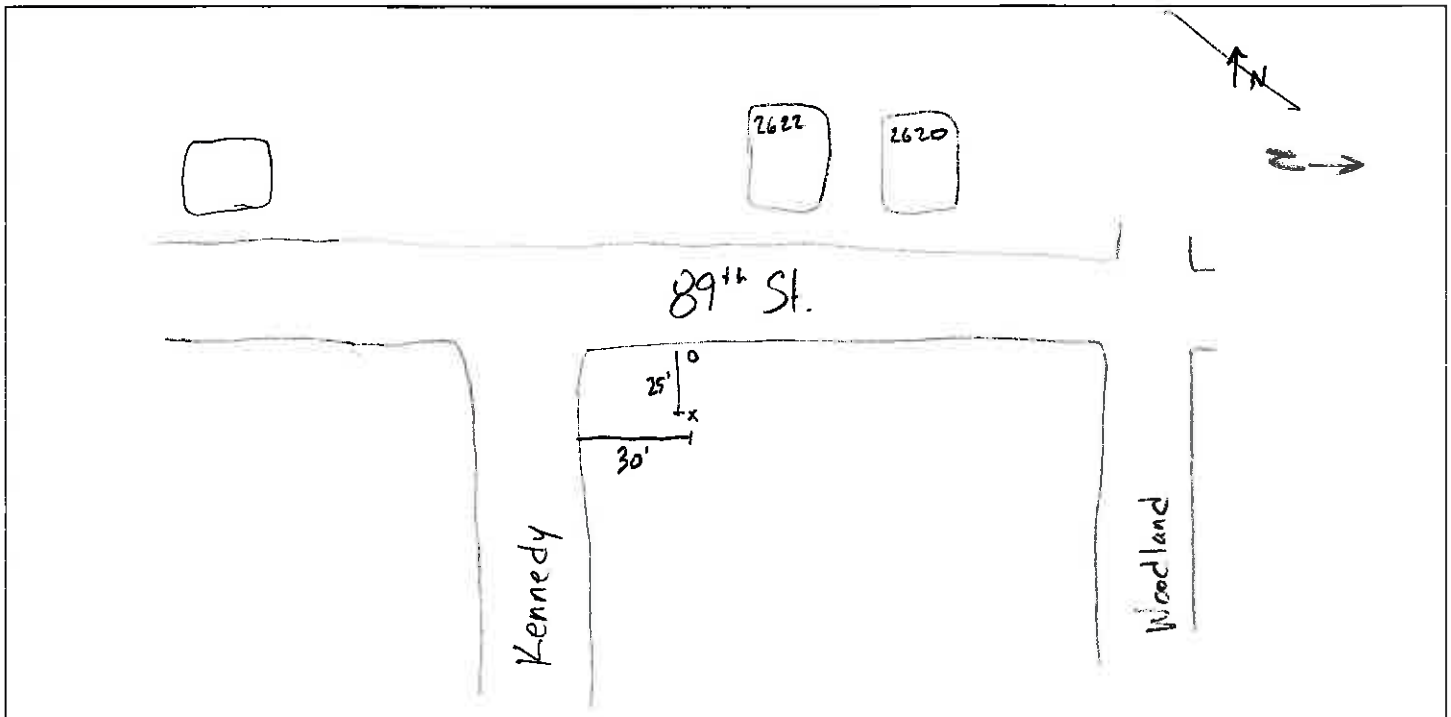
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	~~HHH HHH HHH II~~	52 ~~HHH~~ 5
MED TRKS		
HVY TRKS		
BUS		1
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



Human Voice Removed Leq = 58.3

Added 5:00 - some guy came & talked to me

MEASUREMENT DATA	Duration 20:00 5:00	Leq 64.7 57.7	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 43 HUMIDITY 73% CLOUD COVER Overcast

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: ES-21 DATE: 11-18-10 TIME: 14:11

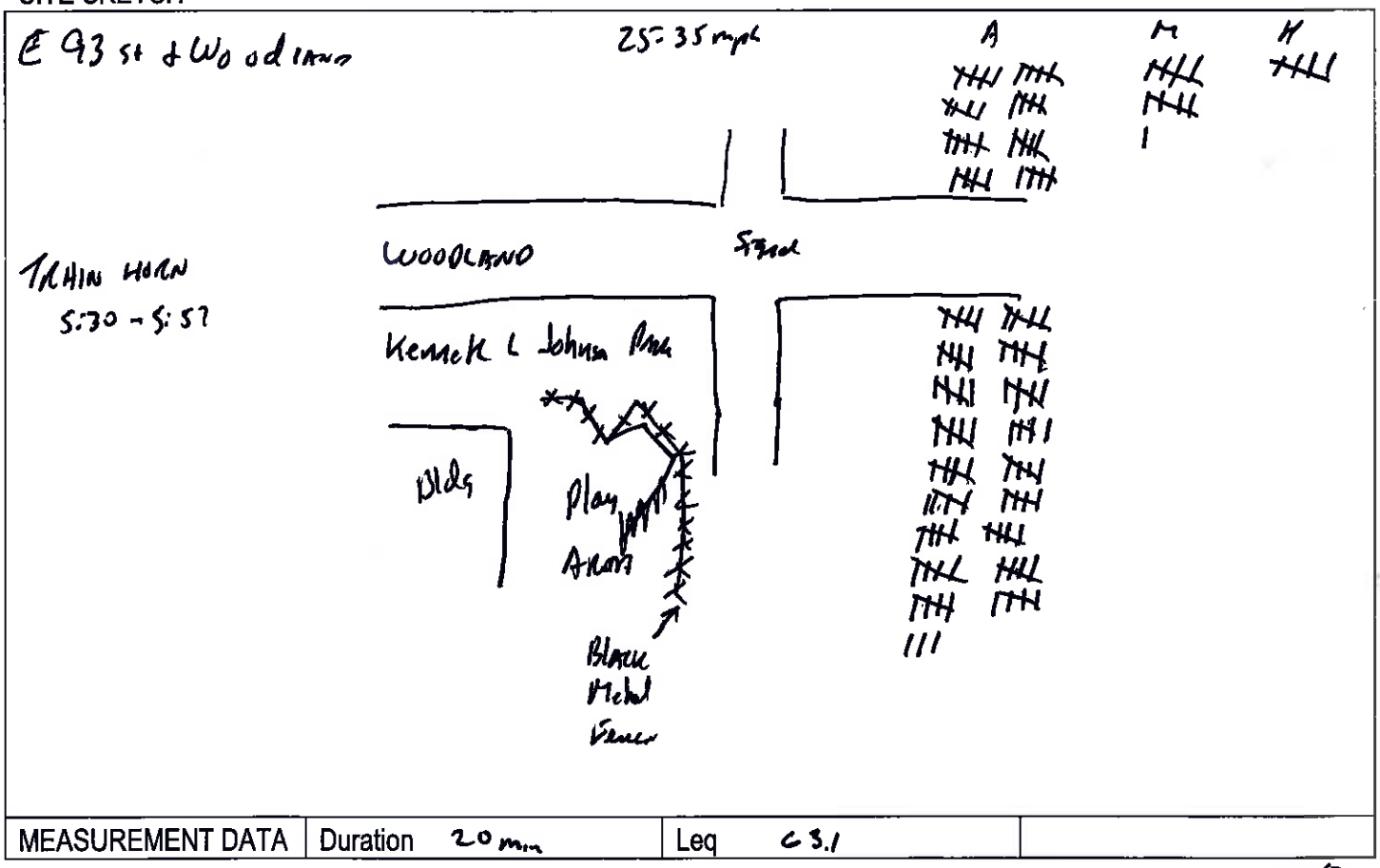
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	133	
MED TRKS	11	
HVY TRKS	5	
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 63.1	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 43 HUMIDITY 79% CLOUD COVER 80%

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-22 DATE: 11-18-10 TIME: 13:40

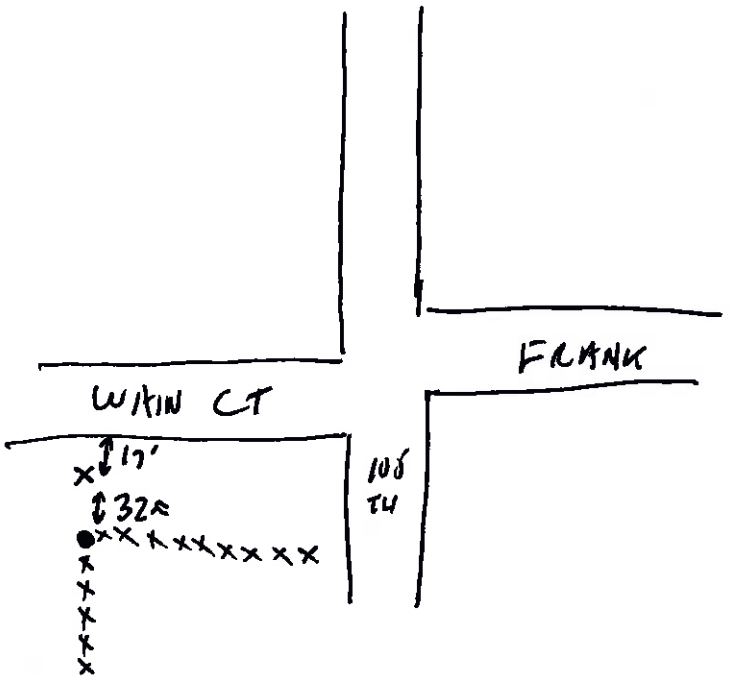
CALIBRATION: 113.8 ~~dB~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	SAME	336
MED TRKS	DATA AT	5
HVY TRKS	FS-23	6
BUS		4
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 56.4	

WEATHER DATA WIND SPEED (MPH) ~~5~~ 9-12 DIR W TEMP. 44 HUMIDITY 76% CLOUD COVER 80%

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: 105th & Wain FS23 DATE: 11-18-10 TIME: 14:39:00

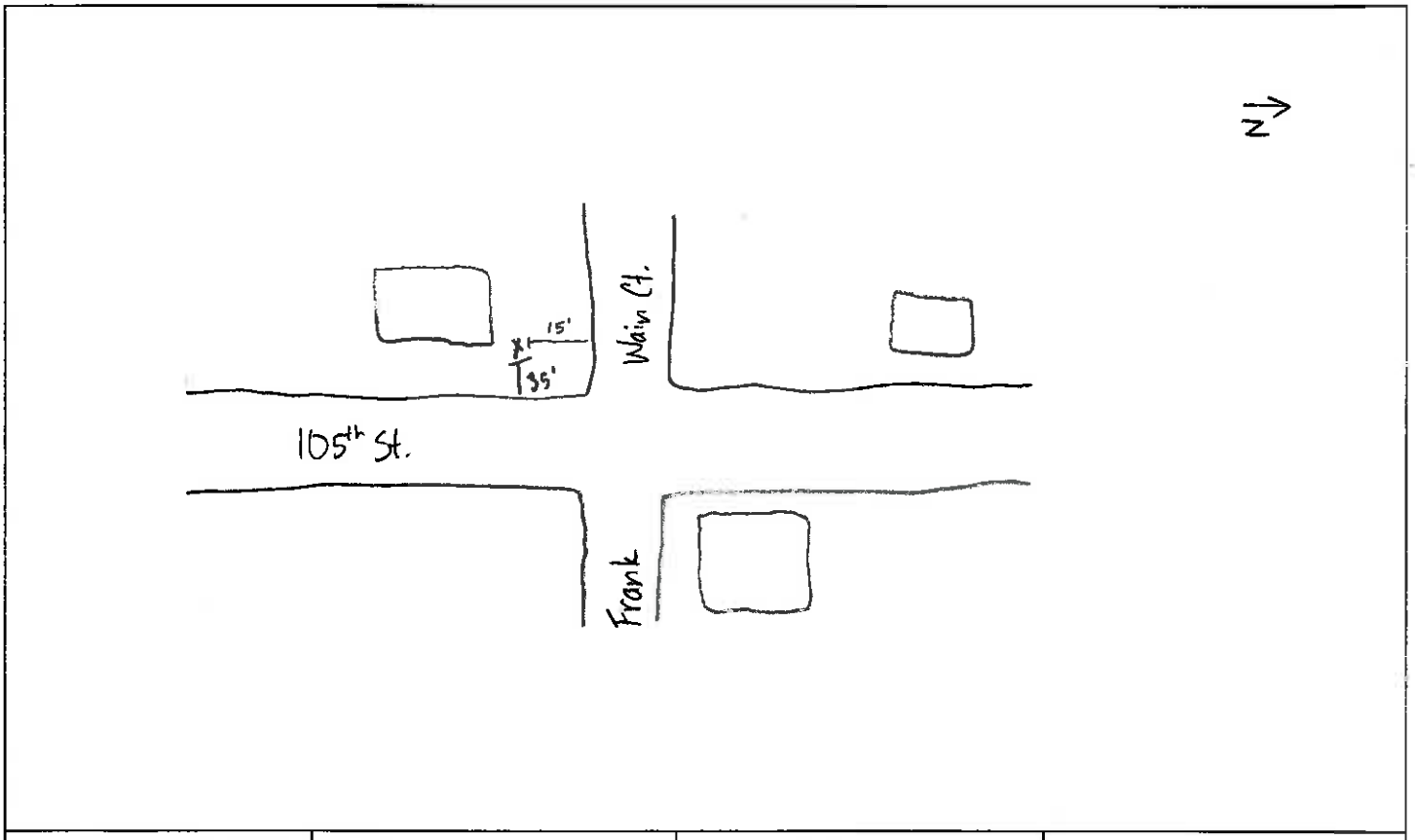
CALIBRATION: 113.8 [redacted] at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		336
MED TRKS		5
HVY TRKS		6
BUS		4
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20:00	Leq 63.8	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 44 HUMIDITY 76% CLOUD COVER Mostly Cloudy

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: DAB

SITE: 105th & Hudson FS-24 DATE: 11-18-10 TIME: 13:47:30

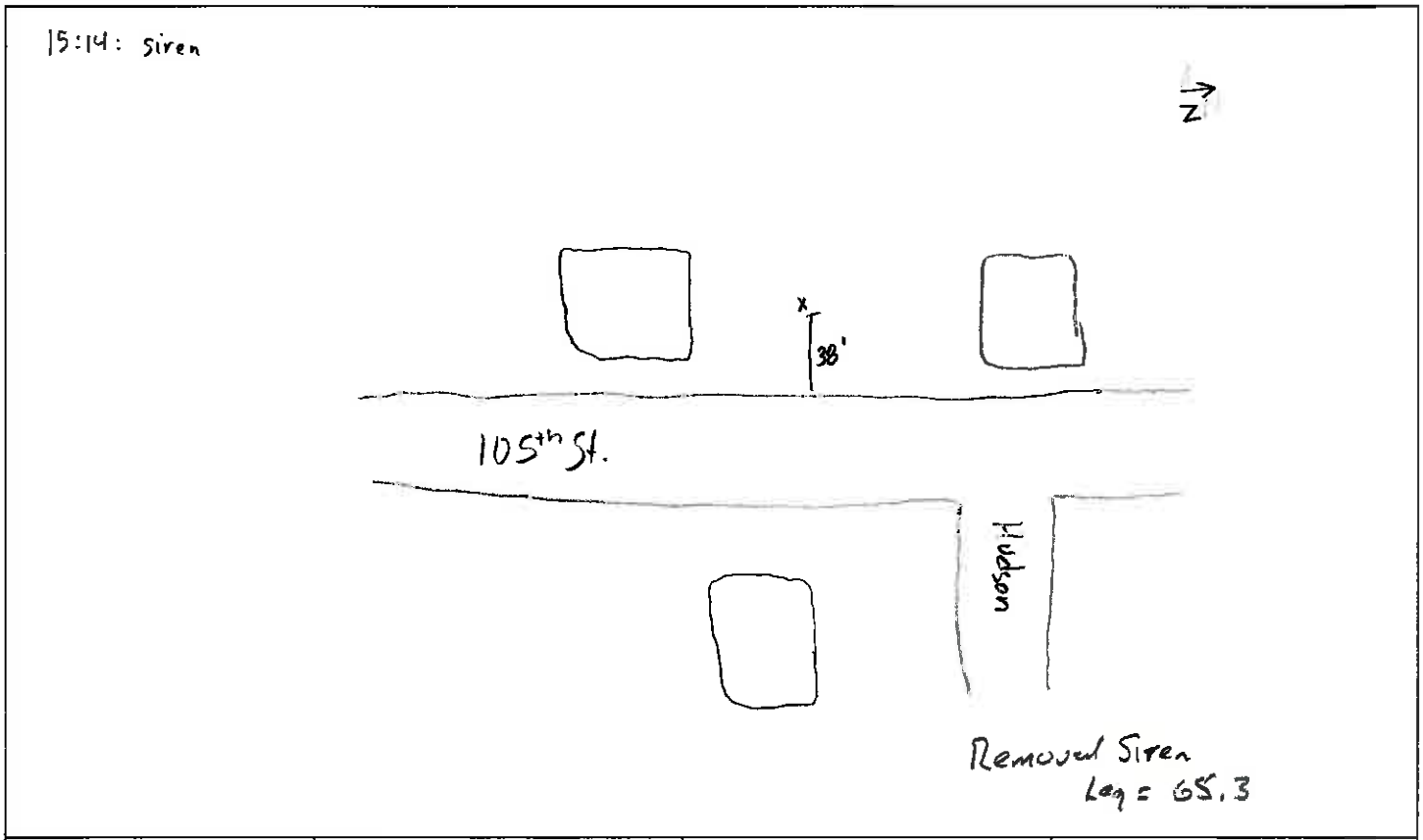
CALIBRATION: 113.8 ~~114~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS		231
MED TRKS		5
HVY TRKS		5
BUS		8
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20:00	Leq 70.4	

WEATHER DATA WIND SPEED (MPH) 9-12 DIR. W TEMP. 43 HUMIDITY 73% CLOUD COVER Overcast

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Opportunity Corridor JOB #: 39853-PL-003-611 BY: ~~SEA~~ JRJ

SITE: FS-25 DATE: 11-18-10 TIME: 14:48

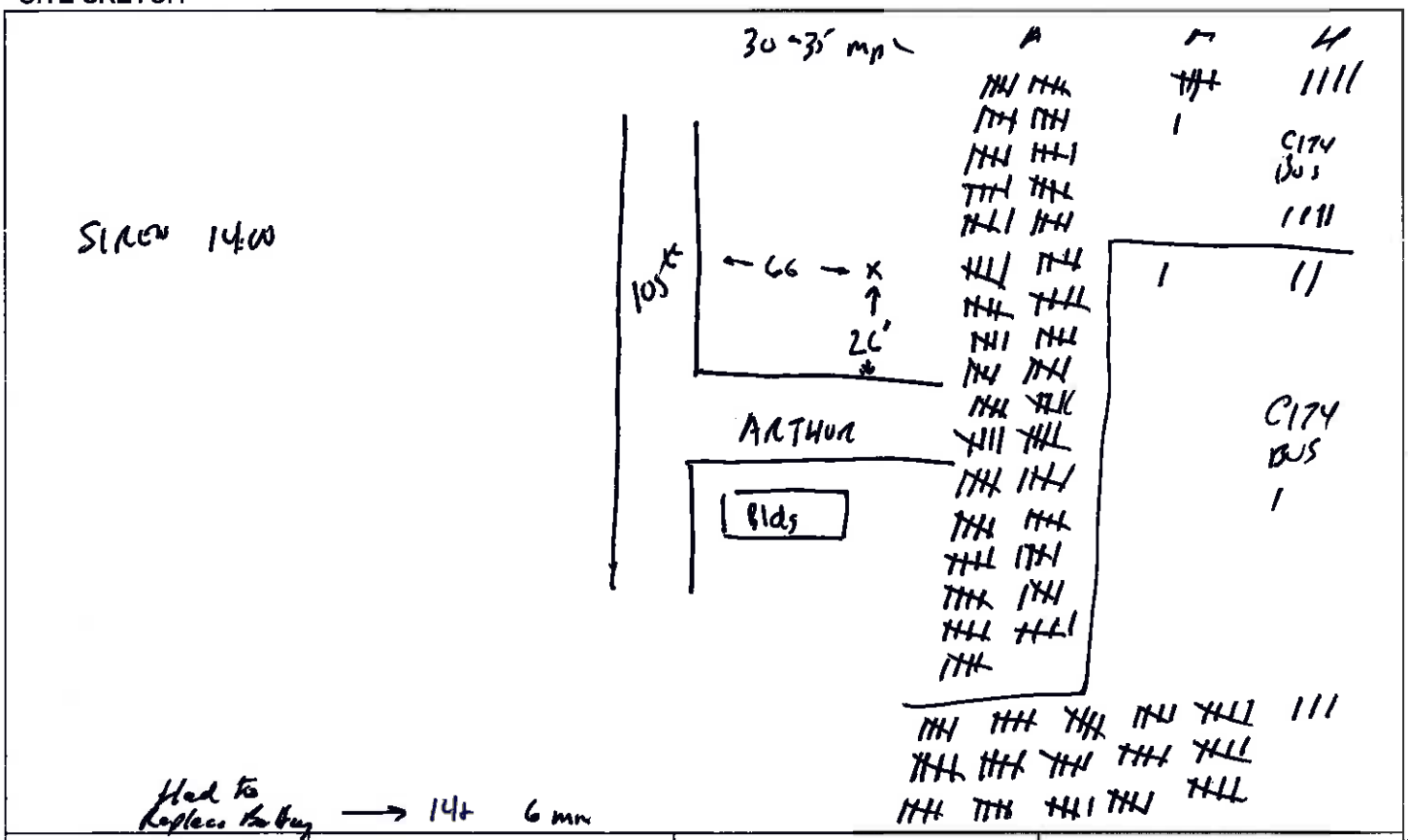
CALIBRATION: 113.8 ~~dB~~ at 1000 Hz dB.

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)		
AUTOS	165/78 = 243	
MED TRKS	6/1 = 7	
HVY TRKS	4/2 = 6	
BUS	4/1 = 5	
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration ~~20~~ ?	Leq	61.9 (Removed Siren) + Combined = Leq 62.5

WEATHER DATA WIND SPEED (MPH) ~~20~~ 3-12 DIR. W TEMP. 43 HUMIDITY 73% CLOUD COVER 80%

BACKGROUND NOISE

MAJOR SOURCES

UNUSUAL EVENTS

OTHER NOTES

Appendix C
Certificates of Calibration

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.22734

Instrument: **Sound Level Meter**
Model: **118**
Manufacturer: **Norsonic**
Serial number: **31361**
Tested with: **Microphone 1225 s/n 48094**
Preamplifier 1206 s/n 30396
Type (class): **1**

Customer: **HNTB Corporation**
Tel/Fax: **414-410-6836 / 414-359-2314**

Date Calibrated: **10/19/2010** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard

Address: **11414 West Park Place, Suite 300, Milwaukee WI 53224**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31071	Jul 6, 2010	Scantek, Inc./ NVLAP	Jul 6, 2011
DS-360-SRS	Function Generator	88077	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2012
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2011
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env./ A2LA	Dec 26, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	30878	Dec 14, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.3 °C	99.99 kPa	42 %RH

Calibrated by	Mariana Buzduga	Checked by	Valentin Buzduga
Signature		Signature	
Date	10/19/2010	Date	10/19/2010

Results summary: Device complies with following clauses of mentioned specifications:

CLAUSES [1] FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	MET[2,3]	NOT MET	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2) [dB]
IEC 60651/ANSI S1.4:			
Input Amplifier Test: Gain Step test/Amplifier Setting (# 6.3/5.3)	X		0.15
Level Linearity Test (#7.9/ 6.9)	X		0.15
Differential Level Linearity (#7.10/6.10)	X		0.21
Weighting Network Tests: A, C, Lin network (#7.2.1/ 6.2.1-electrical test)	X		0.15
Overload Detector Test: A-network (#9.3.1/8.3.1)	X		0.15
F/S/I/Peak Test: Steady State Response (#7.4/ 6.4)	X		0.15
Fast and Slow Overshoot Test (# 8.4.1)	X		0.15
Fast-Slow Test: Single Sine Wave Burst (9.4.1&9.4.3/8.4.1 & 8.4.3)	X		0.15
Impulse Test: Continuous Sine Wave Burst (#7.3/ 6.3)	X		0.15
Impulse Test: Single Sine Wave Burst (#7.3/ 6.3)	X		0.15
Peak Detector Tests: single square wave burst (# 9.4.4/8.4.4)	X		0.15
RMS Detector Test: Continuous Sine Wave Burst (#9.4.2/8.4.2)	X		0.15
RMS Detector Test: Crest Factor Test (#9.4.2/ 8.4.2)	X		0.15
IEC60804/ANSI S1.43			
Level linearity Test (# 9.3.3/8.3.3)	X		0.15
Time Averaging Test (#9.3.2/ 8.3.2) (Leq and LE)	X		0.15/0.17
Acoustical Test: Accuracy at selected frequencies	X		0.15
Global Acoustical response: Summation (#5)	X		0.2
Filter Test: Octave Filters	X		0.15
Filter Test: 1/3 Octave Filters	X		0.15

[1] The results of this calibration apply only to the instrument type with serial number identified in this report.

[2] Parameters are certified at actual environmental conditions.

[3] The tests marked with (*) are not covered by the current NVLAP accreditation.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger. Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

X	Microphone 1225 s/n 48094 for acoustical test
X	Preamplifier 1206 s/n 30396 for all tests
X	Other: line adaptor ADP005 (18pF) for electrical tests

Measured Data: in Test Report # 22734 of 12+1 pages.

Place of Calibration: Scantek, Inc.
6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
and relevant requirements of ISO 9002:1994
ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.22733

Instrument: **Microphone**
Model: **1225**
Manufacturer: **Norsonic**
Serial number: **48094**

Date Calibrated: **10/19/2010** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **HNTB Corporation**
Tel/Fax: **414-410-6836/414-359-2314**

Address: **11414 West Park Place, Suite 300, Milwaukee WI 53224**

Tested in accordance with the following procedures and standards:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31071	Jul 6, 2010	Scantek, Inc./ NVLAP	Jul 6, 2011
DS-360-SRS	Function Generator	88077	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2012
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2011
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env./ A2LA	Dec 26, 2011
PC Program 1017 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	28326	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
1203-Norsonic	Preamplifier	14051	Sep 10, 2010	Scantek, Inc./ NVLAP	Jan 4, 2011
4180-Bruel&Kjaer	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by	Mariana Buzduga	**Checked by**	Valentin Buzduga
Signature		Signature	
Date	10/19/2010	Date	10/19/2010

Document stored as: Z:\Calibration Lab\Mic 2010\NOR1225_48094_M1.doc

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES / METHODS[1] FROM PROCEDURES		MET[2,3]	NOT MET	NOT TESTED	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2)
Open circuit sensitivity (insert voltage method, 250 Hz);		X			See below
Frequency response	Actuator response	X			200 – 8000 Hz: 0.2 dB 8 – 10 kHz: 0.5 dB 10 – 20 kHz: 0.7 dB 20 – 50 kHz: 0.9 dB 50 – 100 kHz: 1.2 dB
	FF/Diffuse field responses	X			200 – 4000 Hz: 0.2 dB 4 – 10 kHz: 0.6 dB 10 – 20 kHz: 0.9 dB 20 – 50 kHz: 2.2 dB 50 – 100 kHz: 4.4 dB
	Scantek, Inc. acoustical method			X	31.5 – 125 Hz: 0.16 dB 250, 1000 Hz: 0.12 dB 2 – 8 kHz: 0.8 dB 12.5 – 16 kHz: 2.4 dB

[1] The results of this calibration apply only to the instrument type with serial number identified in this report.

[2] Parameters are certified at actual environmental conditions.

[3] The tests marked with (*) are not covered by the current NVLAP accreditation.

Note: The free field/diffuse field characteristics were calculated based on the measured actuator response and adjustment coefficients as provided by the manufacturer. The uncertainties reported for these characteristics may include assumed uncertainty components for the adjustment coefficients.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.3 ± 1.0	99.99 ± 0.001	42.0 ± 2.0

Main measured parameters:

Tone frequency (Hz)	Measured[4]/Acceptable Open circuit sensitivity (dB)	Sensitivity (mV/Pa)
250	-25.81 ± 0.12/ -26.0	51.25

[4] The reported expanded uncertainty is calculated with a coverage factor k=2.00

Tests made with following attachments to instrument and auxiliary devices:

	Grid as actuator
X	Actuator type: G.R.A.S. RA 0014
	Coupler type: G.R.A.S. 51 AB

Measured Data: Found on Microphone Test Report # 22733 of one page.

Place of Calibration: Scantek, Inc.
6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.19736

Instrument:	**Sound Level Meter**	*Date Calibrated:*	**5/6/2009**
Model:	**118**	*Status:*	**Received** / **Sent**
Manufacturer:	**Norsonic**	*In tolerance:*	**X** / **X**
Serial number:	**31483**	*Out of tolerance:*	
Tested with:	**Microphone 1225 s/n 52318** **Preamplifier 1206 s/n 30522**	*See comments:*	
Type (class):	**1**	*Contains non-accredited tests:*	**__Yes X No**
		Calibration service:	**__ Basic X Standard**
Customer:	**HNTB Corporation**	*Address:*	**11414 West Park Place, Suite 300** **Milwaukee, WI 53224**
Tel/Fax:	**414-259-2300/ -2314**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Jan 2, 2009	Scantek, Inc.	Jan 2, 2010
DS-360-SRS	Function Generator	33584	Jan 3, 2008	Davis Calibration / AClass	Jan 3, 2010
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Aug 19, 2008	ACR Env. / A2LA	Aug 19, 2009
HM30-Thommen	Meteo Station	1040170/39633	Dec 21, 2007	Transcat / A2LA	Jun 21, 2009
PC Program 1019 Norsonic	Calibration software	v.46	Validated Dec 2006	-	-
1253-Norsonic	Calibrator	25726	Jan 2, 2009	Scantek, Inc.	Jan 2, 2010

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.9 °C	100.43 kPa	50.7 %RH

Calibrated by	Javier Albarracin	Checked by	Mariana Buzduga
Signature		Signature	
Date	5/6/2009	Date	5/6/2009

Document stored as: Z:\Calibration Lab\SLM 2009\NOR118_31483_M1.doc

Results summary: Device complies with following clauses of mentioned specifications:

CLAUSES [1] FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	MET[2,3]	NOT MET	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2) [dB]
IEC 60651/ANSI S1.4:			
Input Amplifier Test: Gain Step test/Amplifier Setting (# 6.3/5.3)	X		0.15
Level Linearity Test (#7.9/ 6.9)	X		0.15
Differential Level Linearity (#7.10/6.10)	X		0.21
Weighting Network Tests: A, C, Lin network (#7.2.1/ 6.2.1-electrical test)	X		0.15
Overload Detector Test: A-network (#9.3.1/8.3.1)	X		0.15
F/S/I/Peak Test: Steady State Response (#7.4/ 6.4)	X		0.15
Fast and Slow Overshoot Test (# 8.4.1)	X		0.15
Fast-Slow Test: Single Sine Wave Burst (9.4.1&9.4.3/8.4.1 & 8.4.3)	X		0.15
Impulse Test: Continuous Sine Wave Burst (#7.3/ 6.3)	X		0.15
Impulse Test: Single Sine Wave Burst (#7.3/ 6.3)	X		0.15
Peak Detector Tests: single square wave burst (# 9.4.4/8.4.4)	X		0.15
RMS Detector Test: Continuous Sine Wave Burst (#9.4.2/8.4.2)	X		0.15
RMS Detector Test: Crest Factor Test (#9.4.2/ 8.4.2)	X		0.15
IEC60804/ANSI S1.43			
Level linearity Test (# 9.3.3/8.3.3)	X		0.15
Time Averaging Test (#9.3.2/ 8.3.2) (Leq and LE)	X		0.15/0.17
Acoustical Test: Accuracy at selected frequencies	X		0.15
Filter Test: Octave Filters	X		0.15
Filter Test: 1/3 Octave Filters	X		0.15

[1] The results of this calibration apply only to the instrument type with serial number identified in this report

[2] Parameters are certified at actual environmental conditions

[3] The tests marked with (*) are not covered by the current NVLAP accreditation

Comments: The instrument was tested and met all specifications found in the referenced procedures

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger. Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

X	Microphone 1225 s/n 52318 for acoustical test
X	Preamplifier 1206 s/n 30522 for all tests
X	Other: line adaptor ADP005 (18pF) for electrical tests

Measured Data: in Test Report # 19736 of 11+1 pages.

Place of Calibration: Scantek, Inc.
6450 Dobbin Road, Suite A
Columbia, MD 21045 USA
Ph/Fax: 410-290-7726/ -9167
info@scantekinc.com

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
and relevant requirements of ISO 9002:1994
ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.19737

Instrument: **Microphone**
Model: **1225**
Manufacturer: **Norsonic**
Serial number: **52318**

Date Calibrated: **5/5/2009**

Status	**Received**	**Sent**
In tolerance	X	X
Out of tolerance		
See comments		

Contains non-accredited tests: __Yes _X_ No

Customer: **HNTB Corporation**
Tel/Fax: **414-259-2300/ -2314**

Address: **11414 West Park Place, Suite 300**
Milwaukee, WI 53224

Tested in accordance with the following procedures and standards:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Jan 2, 2009	Scantek, Inc.	Jan 2, 2010
DS-360-SRS	Function Generator	33584	Jan 3, 2008	Davis Calibration / AClass	Jan 3, 2010
34401A-Agilent	Digital Voltmeter	US36120731	Aug 19,	ACR Env. / A2LA	Aug 19, 2009
HM30-Thommen	Meteo Station	1040170/39633	Dec 21,	Transcat / A2LA	Jun 21, 2009
PC Program 1017 Norsonic	Calibration software	v.46	Validated Feb 2006	-	-
1253-Norsonic	Calibrator	22909	Jan 2, 2009	Scantek, Inc.	Jan 2, 2010
1203-Norsonic	Preamplifier	14059	Jan 2, 2009	Scantek, Inc./ NVLAP	Jan 2, 2010
4180-Bruel&Kjaer	Microphone	2246115	Mar 7, 2008	NPL (UK) / UKAS	Mar 7, 2010

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by	Javier Albarracin	Checked by	Mariana Buzduga
Signature		Signature	
Date	5/5/2009	Date	5/6/2009

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES / METHODS[1] FROM PROCEDURES		MET[2,3]	NOT MET	NOT TESTED	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2)
Open circuit sensitivity (insert voltage method, 250 Hz);		X			See below
Frequency response	Actuator response	X			200 - 8000 Hz: 0.2 dB 8 - 10 kHz: 0.5 dB 10 - 20 kHz: 0.7 dB
	FF/Diffuse field responses	X			200 - 4000 Hz: 0.2 dB 4 - 10 kHz: 0.6 dB 10 - 20 kHz: 0.9 dB
	Scantek Inc. acoustical method			X	31.5 – 125 Hz: 0.16 dB 250, 1000 Hz: 0.12 dB 2 - 8 kHz: 0.8 dB 12.5 – 16 kHz: 2.4 dB

[1] The results of this calibration apply only to the instrument type with serial number identified in this report

[2] Parameters are certified at actual environmental conditions

[3] The tests marked with (*) are not covered by the current NVLAP accreditation

Note: The free field/diffuse field characteristics were calculated based on the measured actuator response and adjustment coefficients as provided by the manufacturer. The uncertainties reported for these characteristics may include assumed uncertainty components for the adjustment coefficients.

Comments: The instrument was tested and met all specifications found in the referenced procedures

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.5 ± 1.0	100.53 ± 0.011	49.5 ± 2.1

Main measured parameters:

Tone frequency (Hz)	Measured[4]/Nominal Open circuit sensitivity (dB)	Sensitivity (mV/Pa)
250	-26.27 ± 0.12/ -26.0	48.57

[4] The reported expanded uncertainty is calculated with a coverage factor k=2.00

Tests made with following attachments to instrument and auxiliary devices:

	Grid as actuator
X	Actuator type: G.R.A.S RA 0014
	Coupler type: GRAS 51 AB

Measured Data: Found on Microphone Test Report # 19737 of one page.

Place of Calibration: Scantek, Inc
6450 Dobbin Road, Suite A
Columbia, MD 21045 USA
Ph/Fax: 410-290-7726/ -9167
info@scantekinc.com

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.22735

Instrument: **Acoustical Calibrator**
Model: **1251**
Manufacturer: **Norsonic**
Serial number: **30825**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **10/19/2010** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **HNTB Corporation**
Tel/Fax: **414-410-6836 / 414-359-2314**

Address: **11414 West Park Place, Suite 300, Milwaukee WI 53224**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., 06/06/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31071	Jul 6, 2010	Scantek, Inc./ NVLAP	Jul 6, 2011
DS-360-SRS	Function Generator	88077	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2012
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2011
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env./ A2LA	Dec 26, 2011
140-Norsonic	Real Time Analyzer	1403978	Mar 4, 2010	Scantek, Inc. / NVLAP	Mar 4, 2011
PC Program 1018 Norsonic	Calibration software	v.5.0	Validated July 2009	-	
1253-Norsonic	Calibrator	28326	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
1203-Norsonic	Preamplifier	14051	Sep 10, 2010	Scantek, Inc./ NVLAP	Sep 10, 2011
4180-Bruel&Kjaer	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by	Mariana Buzduga	Checked by	Valentin Buzduga
Signature		Signature	
Date	10/19/2010	Date	10/19/2010

Document stored as: Z:\Calibration Lab\Cal 2010\NOR1251_30825_M1.doc

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES[1] FROM STANDARDS REFERENCED IN PROCEDURES:	MET[2]	NOT MET	COMMENTS
Manufacturer specifications	X		
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion			
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		

[1] The results of this calibration apply only to the instrument type with serial number identified in this report.

[2] The tests marked with (*) are not covered by the current NVLAP accreditation.

Main measured parameters[3]:

Measured[4]/Acceptable Tone frequency (Hz):	Measured[4]/Acceptable Total Harmonic Distortion (%):	Measured [4]/Acceptable Level (dB):
1000.25 ± 1.0/1000.0 ± 10.0	0.2 ± 0.5/ < 3	114.12 ± 0.10/114.0 ± 0.4

[3] Parameters are certified at actual environmental conditions.

[4] The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=2.00

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.4 ± 1.0	100.00 ± 0.001	40.2 ± 2.0

Tests made with following attachments to instrument:

X	Calibrator ½" Adaptor Type 1443
	Other

Adjustments: Unit was not adjusted.
Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger. Compliance with any standard cannot be claimed based solely on the periodic tests.

Measured Data: in Acoustical Calibrator Test Report # 22735 of one page.

Place of Calibration: Scantek, Inc.
6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

Acoustical Calibrator Test Report No.:22735

Manufacturer:	**Norsonic**
Type:	**1251**
Serial no:	**30825**

Customer:	**HNTB Corporation**
Department:	
Place:	**11414 West Park Place, Suite 300, Milwaukee WI 53224**
Order No:	
Contact Person:	**Suheil Acra**
Phone No.:	**414-410-6836**
Fax No.:	**414-359-2314**
eMail:	**sacra@hntb.com**

Measurement Results:

	Level: (dB)	P. Stab : (dB)	Frequency: (Hz)	F. Stab : (%)	Distortion: (% TD)
1:	114.11	0.06	1000.26	0.00	0.23
2:	114.12	0.05	1000.25	0.00	0.23
3:	114.12	0.06	1000.25	0.00	0.23
Result (Average):	**114.12**	**0.06**	**1000.25**	**0.00**	**0.23**
Expanded Uncertainty:	0.10	0.02	1.00	0.01	0.50
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20μPa.

The following correction factors have been applied during the measurement:
Pressure:0.0005 dB/kPa Temperature: None Relative humidity: None
Reference microphone: 40AG-06535. Volume correction: 0.000 dB
Records:Z:\Calibration Lab\Cal 2010\NOR1251_30825_M1.nmf

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
100.000 ± 0.001 kPa	24.4 ± 1.0 °C	40.2 ± 2.0 %RH

Date of calibration: 10/19/2010
Date of issue: 10/19/2010

Supervisor : Valentin Buzduga
Measurements performed by:

MB

Mariana Buzduga
Software version: 5.0

Scantek, Inc.
6430 Dobbin Rd., Suite C, Columbia, MD 21045
Ph: 410-290-7726 eMail: callab@scantekinc.com

Appendix D
TNM Traffic Data

Opportunity Corridor Traffic

Existing TNM Traffic Volumes

	EB I-490, west of 55th St.		WB I-490, west of 55th St.		NB 55th St., south of I-490		SB 55th St., south of I-490		NB 55th St., north of I-490		SB 55th St., north of I-490		57th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**1992**		**1196**		**623**		**546**		**1852**		**979**		**30**	
Autos	1833	40	1100	40	573	40	502	40	1704	40	901	40	30	25
Med Trx	82	40	49	40	26	40	22	40	76	40	40	40	0	0
Heavy Trx	78	40	47	40	24	40	21	40	72	40	38	40	0	0
Total	**1992**		**1196**		**623**		**546**		**1852**		**979**		**30**	

	Bower Rd.		61st St.		Butler & 64th St.		Berwick Rd.		WB Kinsman		EB Kinsman		75th St., south of Grand and 75th St., north of Grand	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**30**		**30**		**12**		**12**		**1780**		**769**		**142**	
Autos	30	25	30	25	12	30	12	30	1702	40	735	40	137	30
Med Trx	0	0	0	0	0	0	0	0	59	40	25	40	3	30
Heavy Trx	0	0	0	0	0	0	0	0	20	40	8	40	2	30
Total	**30**		**30**		**12**		**12**		**1780**		**769**		**142**	

	79th St., south of Grand		79th St., north of Grand		Grand, west of 75th St. and Grand, between 75th and 79th		Grand, southwest of Buckeye		Evarts		WB Buckeye		EB Buckeye	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**820**		**670**		**33**		**15**		**6**		**775**		**421**	
Autos	766	30	626	30	33	30	15	30	6	25	762	40	414	40
Med Trx	39	30	31	30	0	0	0	0	0	0	8	40	4	40
Heavy Trx	16	30	13	30	0	0	0	0	0	0	5	40	3	40
Total	**820**		**670**		**33**		**15**		**6**		**775**		**421**	

	89th St., south of Woodland		89th St., north of Woodland		93rd St., south of Woodland and 93rd St., north of Woodland		EB Woodland, west of 89th St.		WB Woodland, west of 89th St.		EB Woodland, east of 89th St.		WB Woodland, east of 89th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**88**		**37**		**173**		**481**		**341**		**879**		**685**	
Autos	85	30	36	30	168	30	467	40	331	40	854	40	665	40
Med Trx	2	30	1	30	3	30	8	40	6	40	15	40	12	40
Heavy Trx	1	30	1	30	2	30	6	40	4	40	11	40	8	40
Total	**88**		**37**		**173**		**481**		**341**		**879**		**685**	

	Quincy, east of 105th St.		Quincy, west of 105th St.		EB Cedar, east of 105th St.		EB Cedar, west of 105th St.		WB Cedar, east of 105th St.		WB Cedar, west of 105th St.		EB Carnegie, east of 105th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**1007**		**508**		**464**		**492**		**364**		**290**		**1699**	
Autos	986	40	497	40	458	40	485	40	359	40	286	40	1696	40
Med Trx	20	40	10	40	5	40	5	40	4	40	3	40	2	40
Heavy Trx	1	40	1	40	2	40	2	40	1	40	1	40	2	40
Total	**1007**		**508**		**464**		**492**		**364**		**290**		**1699**	

	EB Carnegie, west of 105th St.		WB Carnegie, east of 105th St.		WB Carnegie, west of 105th St.		EB Euclid, east of 105th St.		EB Euclid, west of 105th St.		WB Euclid, east of 105th St.		WB Euclid, west of 105th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**1688**		**891**		**943**		**452**		**435**		**453**		**484**	
Autos	1685	40	889	40	941	40	425	30	409	30	426	30	455	30
Med Trx	2	40	1	40	1	40	23	30	22	30	23	30	25	30
Heavy Trx	2	40	1	40	1	40	4	30	3	30	4	30	4	30
Total	**1688**		**891**		**943**		**452**		**435**		**453**		**484**	

	EB Chester, east of 105th St.		EB Chester, west of 105th St.		WB Chester, east of 105th St.		WB Chester, west of 105th St.		NB 105th St., Quincy to Cedar		SB 105th St., Cedar to Quincy		NB 105th St., Cedar to Carnegie	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**1656**		**779**		**645**		**1793**		**359**		**509**		**459**	
Autos	1646	40	774	40	641	40	1782	40	351	30	498	30	446	30
Med Trx	7	40	3	40	3	40	7	40	7	30	10	30	11	30
Heavy Trx	3	40	2	40	1	40	4	40	0	0	1	30	2	30
Total	**1656**		**779**		**645**		**1793**		**359**		**509**		**459**	

	SB 105th St., Carnegie to Cedar		NB 105th St., Carnegie to Euclid		SB 105th St., Euclid to Carnegie		NB 105th St., Euclid to Chester		SB 105th St., Chester to Euclid		NB 105th St., north of Chester		SB 105th St, north of Chester	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**417**		**708**		**523**		**638**		**480**		**671**		**476**	
Autos	405	30	693	30	512	30	619	30	466	30	654	30	464	30
Med Trx	10	30	14	30	10	30	13	30	10	30	15	30	11	30
Heavy Trx	2	30	1	30	1	30	5	30	4	30	1	30	1	30
Total	**417**		**708**		**523**		**638**		**480**		**671**		**476**	

Future TNM Traffic Volumes

	NB 55th St., south of OC Ramp		SB 55th St., south of OC Ramp		NB 55th St., north of OC Ramp		SB 55th St., north of OC Ramp		OC Off Ramp to 55th St. (one lane) and OC Off Ramp to 55th St. (two lane)		OC On Ramp from 55th St. (one lane) and OC On Ramp from 55th St. (two lane)		59th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**1350**		**510**		**1080**		**370**		**460**		**440**		**30**	
Autos	1316	40	497	40	1053	40	361	40	449	25	429	25	30	25
Med Trx	20	40	8	40	16	40	6	40	7	25	7	25	0	0
Heavy Trx	14	40	5	40	11	40	4	40	5	25	4	25	0	0
Total	**1350**		**510**		**1080**		**370**		**460**		**440**		**30**	

	Bower Rd.		61st St.		Butler & 64th St.		Berwick Rd.		EB Kinsman, south of OC		WB Kinsman, south of OC		EB Kinsman, north of OC	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed		
Volume	**30**		**30**		**12**		**12**		**510**		**370**		**270**	
Autos	30	25	30	25	12	30	12	30	503	40	365	40	266	40
Med Trx	0	0	0	0	0	0	0	0	4	40	3	40	2	40
Heavy Trx	0	0	0	0	0	0	0	0	3	40	2	40	1	40
Total	**30**		**30**		**12**		**12**		**510**		**370**		**270**	

	WB Kinsman, north of OC		75th St., south of OC		75th St., north of OC		79th St., south of OC		79th St., north of OC		Grand, west of 75th St. and Grand, between 75th and 79th		Evarts	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**250**		**100**		**130**		**920**		**550**		**33**		**6**	
Autos	247	40	97	30	126	30	890	30	532	30	33	30	6	25
Med Trx	2	40	2	30	2	30	18	30	11	30	0	0	0	0
Heavy Trx	1	40	1	30	2	30	12	30	7	30	0	0	0	0
Total	**250**		**100**		**130**		**920**		**550**		**33**		**6**	

	EB Buckeye, south of OC		WB Buckeye, south of OC		EB Buckeye, north of OC		WB Buckeye, north of OC		93rd St., south of Woodland and 93rd St., north of Woodland, south of OC		93rd St., north of OC		EB Woodland, west of 89th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**540**		**1120**		**440**		**580**		**760**		**1310**		**290**	
Autos	527	40	1092	40	429	40	566	40	745	30	1284	30	284	40
Med Trx	8	40	17	40	7	40	9	40	9	30	16	30	3	40
Heavy Trx	5	40	11	40	4	40	6	40	6	30	10	30	2	40
Total	**540**		**1120**		**440**		**580**		**760**		**1310**		**290**	

	WB Woodland, west of 89th St.		EB Woodland, east of 89th St.		WB Woodland, east of 89th St.		Quincy, west of 105th St.		EB Cedar, east of 105th St.		EB Cedar, west of 105th St.		WB Cedar, east of 105th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**210**		**1070**		**780**		**150**		**760**		**390**		**420**	
Autos	206	40	1049	40	764	40	146	40	733	40	376	40	405	40
Med Trx	3	40	13	40	9	40	2	40	16	40	8	40	9	40
Heavy Trx	2	40	9	40	6	40	2	40	11	40	5	40	6	40
Total	**210**		**1070**		**780**		**150**		**760**		**390**		**420**	

	WB Cedar, west of 105th St.		EB Carnegie, east of 105th St.		EB Carnegie, west of 105th St.		WB Carnegie, east of 105th St.		WB Carnegie, west of 105th St.		EB Euclid, east of 105th St.		EB Euclid, west of 105th St.	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**280**		**1520**		**1470**		**980**		**860**		**470**		**700**	
Autos	270	40	1467	40	1419	40	946	40	830	40	461	30	686	30
Med Trx	6	40	32	40	31	40	21	40	18	40	6	30	8	30
Heavy Trx	4	40	21	40	21	40	14	40	12	40	4	30	6	30
Total	**280**		**1520**		**1470**		**980**		**860**		**470**		**700**	

	WB Euclid, east of 105th St.		WB Euclid, west of 105th St.		EB Chester, east of 105th St.		EB Chester, west of 105th St.		WB Chester, east of 105th St.		WB Chester, west of 105th St.		I-490 to OC Ramp (2 lane)	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**680**		**690**		**1530**		**1600**		**540**		**650**		**1373**	
Autos	666	30	676	30	1461	40	1528	40	516	40	621	40	1339	40
Med Trx	8	30	8	30	41	40	43	40	15	40	18	40	21	40
Heavy Trx	5	30	6	30	28	40	29	40	10	40	12	40	14	40
Total	**680**		**690**		**1530**		**1600**		**540**		**650**		**1373**	

	I-490 to OC Ramp (1 lane)		EB OC to Off Ramp		WB OC, Ramp to I-490		EB OC, Ramp to Kinsman		WB OC, Kinsman to Ramp		EB OC, Kinsman to 75		WB OC, 75 to Kinsman	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**687**		**2060**		**1520**		**2020**		**1500**		**1860**		**1250**	
Autos	670	40	2009	40	1482	40	1970	40	1463	40	1808	40	1213	40
Med Trx	10	40	31	40	23	40	30	40	23	40	32	40	23	40
Heavy Trx	7	40	21	40	15	40	20	40	15	40	21	40	15	40
Total	**687**		**2060**		**1520**		**2020**		**1500**		**1860**		**1250**	

	EB OC, 75th to 79th		WB OC, 79th to 75th		EB OC, 79th to Buckeye		WB OC, Buckeye to 79th		EB OC, Buckeye to 89th		WB OC, 89th to Buckeye		EB OC, 89th to 93rd	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**1850**		**1250**		**1810**		**1180**		**2000**		**1010**		**1920**	
Autos	1795	40	1213	40	1750	40	1141	40	1950	40	985	40	1882	40
Med Trx	33	40	23	40	36	40	23	40	30	40	15	40	23	40
Heavy Trx	22	40	15	40	24	40	16	40	20	40	10	40	15	40
Total	**1850**		**1250**		**1810**		**1180**		**2000**		**1010**		**1920**	

Future TNM Traffic Volumes (continued)														
	WB OC, 93rd to 89th		EB OC, 93rd to Quincy		WB OC, Quincy to 93rd		NB 105th St., Quincy to Cedar		SB 105th St, Cedar to Quincy		NB 105th St, Cedar to Carnegie		SB 105th St, Carnegie to Cedar	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**800**		**1680**		**630**		**1500**		**620**		**1120**		**560**	
Autos	784	40	1638	40	614	40	1434	30	593	30	1060	30	530	30
Med Trx	10	40	25	40	9	40	51	30	21	30	45	30	22	30
Heavy Trx	6	40	17	40	6	40	15	30	6	30	16	30	8	30
Total	**800**		**1680**		**630**		**1500**		**620**		**1120**		**560**	

	NB 105th St., Carnegie to Euclid		SB 105th, Euclid to Carnegie		NB 105th St., Euclid to Chester		SB105th St, Chester to Euclid		NB 105th St., north of Chester		SB 105th St, north of Chester	
	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed	Traffic	Speed
Volume	**730**		**870**		**870**		**710**		**850**		**700**	
Autos	691	30	823	30	836	30	682	30	796	30	655	30
Med Trx	29	30	35	30	27	30	22	30	39	30	32	30
Heavy Trx	10	30	12	30	7	30	6	30	15	30	13	30
Total	**730**		**870**		**870**		**710**		**850**		**700**	

Appendix E
Noise Barrier Analysis Tables

NB1: South side of OC Mainline Between Kinsman Rd and East End of the Bridge Over the GCRTA Blue and Green Line

Feasibility Criteria

Provides a minimum 5 dB(A) reduction for 40% of the impacted receptors.

Reasonability Criteria

Noise reduction design goal = At least 7 dB(A) for one benefited receptor.
Benefited receptor = Noise reduction of at least 5 dB(A).
Reasonable Cost per Dwelling Unit less than or equal to $35,000 per benefited receptor.

	Noise Barrier 1					
	Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
	N21	Darlene Jackson/6829 Colfax Rd	2	***65.5***	57.1	-8.4
	N22	Lodis Litzsey/6833 Colfax Rd	2	63.4	58.7	-4.7
	N23	Howard McGhee/6835 Colfax Rd	2	62.6	58.6	-4.0
NB1: TNM Maximum Height Modeled - 15'	**Feasibility**					
	% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
	Reasonability					
	Number of receptors with at least 7 dB(A) reduction	2	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
	815	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**No**	
	15' for NB; 15.5' bridge parapet + NB	Height, ft				
	6,248	Noise Barrier Area, sq ft				
	4,776	Noise Barrier Bridge Area, sq ft				
	$25	Noise Barrier Cost per sq ft				
	$50	Noise Barrier Cost per sq ft (on structure)				
	$395,000	Cost of noise barrier				
	4	benefited receptors				
	$98,750	Cost per benefited receptors				
	Other Considerations					
	Does this design pass the TNM Line of Sight?				**N/A**	

	Noise Barrier 1					
	Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
	N21	Darlene Jackson/6829 Colfax Rd	2	***65.5***	59.0	-6.5
	N22	Lodis Litzsey/6833 Colfax Rd	2	63.4	58.6	-4.8
	N23	Howard McGhee/6835 Colfax Rd	2	62.6	58.6	-4.0
NB1: Recommended Barrier Design	**Feasibility**					
	% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
	Reasonability					
	Number of receptors with at least 7 dB(A) reduction	2	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
	732	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**No**	
	8' for NB; 7.5' bridge parapet + NB	Height, ft				
	2,676	Noise Barrier Area, sq ft				
	1,592	Noise Barrier Bridge Area, sq ft				
	$25	Noise Barrier Cost per sq ft				
	$50	Noise Barrier Cost per sq ft (on structure)				
	$146,500	Cost of noise barrier				
	4	benefited receptors				
	$36,625	Cost per benefited receptors				
	Other Considerations					
	Does this design pass the TNM Line of Sight?				**N/A**	

NB2: South side of OC Mainline Between 71st Place and 75th Street

Feasibility Criteria

Provides a minimum 5 dB(A) reduction for 40% of the impacted receptors.

Reasonability Criteria

Noise reduction design goal = At least 7 dB(A) for one benefited receptor.
Benefited receptor = Noise reduction of at least 5 dB(A).
Reasonable Cost per Dwelling Unit less than or equal to $35,000 per benefited receptor.

NB2: TNM Maximum Height Modeled - 15'

Noise Barrier 2					
Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
N24	Frederick Clemmons/2796 E 73rd St	3	63.7	56.3	-7.4
N25	Jeanette Dawson/2798 E 73rd St	1	60.6	56.3	-4.3
N26	Hilda Phillips/2804 E 73rd St	1	59.6	56.0	-3.6
N27	Rosalyn Mcollom/2787 E 73rd St	2	***67.4***	56.0	-11.4
N28	Pleasant Properties, LP/2791 E 73rd St	1	64.0	56.1	-7.9
N29	Pleasant Properties, LP/2795 E 73rd St	1	60.9	56.2	-4.7
N30	Pleasant Properties, LP/2799 E 73rd St	1	59.4	55.8	-3.6
N31	Darryl Powell/2805 E 73rd St	1	58.7	55.5	-3.2
Feasibility					
% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
Reasonability					
Number of receptors with at least 7 dB(A) reduction	6	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
609	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**Yes**	
15	Height, ft				
9,136	Area, sq ft				
$25	Noise Barrier Cost per sq ft				
$228,400	Cost of noise barrier				
7	benefited receptors				
$32,629	Cost per benefited receptors				
Other Considerations					
Does this design pass the TNM Line of Sight?				**Yes**	

NB2: Recommended Barrier Design

Noise Barrier 2					
Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
N24	Frederick Clemmons/2796 E 73rd St	3	63.7	57.1	-6.6
N25	Jeanette Dawson/2798 E 73rd St	1	60.6	56.5	-4.1
N26	Hilda Phillips/2804 E 73rd St	1	59.6	56.2	-3.4
N27	Rosalyn Mcollom/2787 E 73rd St	2	***67.4***	57.0	-10.4
N28	Pleasant Properties, LP/2791 E 73rd St	1	64.0	56.7	-7.3
N29	Pleasant Properties, LP/2795 E 73rd St	1	60.9	56.5	-4.4
N30	Pleasant Properties, LP/2799 E 73rd St	1	59.4	56.1	-3.3
N31	Darryl Powell/2805 E 73rd St	1	58.7	55.7	-3.0
Feasibility					
% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
Reasonability					
Number of receptors with at least 7 dB(A) reduction	6	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
609	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**Yes**	
11 - 14	Height, ft				
7,580	Area, sq ft				
$25	Noise Barrier Cost per sq ft				
$189,500	Cost of noise barrier				
6	benefited receptors				
$31,583	Cost per benefited receptors				
Other Considerations					
Does this design pass the TNM Line of Sight?				**Yes**	

NB3: North side of OC Mainline Between eastern edge of Bridge Over the GCRTA Blue and Green Track Lines and 75th Street

Feasibility Criteria

Provides a minimum 5 dB(A) reduction for 40% of the impacted receptors.

Reasonability Criteria

Noise reduction design goal = At least 7 dB(A) for one benefited receptor.
Benefited receptor = Noise reduction of at least 5 dB(A).
Reasonable Cost per Dwelling Unit less than or equal to $35,000 per benefited receptor.

	Noise Barrier 3					
	Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
	N34	Dorothy Perryman/7024 Grand Ave	2	65.3	53.9	-11.4
	N35	Catherine Morris/7102 Grand Ave	4	***66.9***	54.3	-12.6
	N36	Phyllis McKinney/7202 Grand Ave	1	***67.3***	54.9	-12.4
	Feasibility					
	% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
NB3: TNM Maximum Height Modeled - 15'	**Reasonability**					
	Number of receptors with at least 7 dB(A) reduction	7	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
	943	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**No**	
	15	Height, ft				
	14,138	Area, sq ft				
	$25	Noise Barrier Cost per sq ft				
	$353,450	Cost of noise barrier				
	7	benefited receptors				
	$50,493	Cost per benefited receptors				
	Other Considerations					
	Does this design pass the TNM Line of Sight?				**N/A**	

	Noise Barrier 3					
	Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
	N34	Dorothy Perryman/7024 Grand Ave	2	65.3	56.4	-8.9
	N35	Catherine Morris/7102 Grand Ave	4	***66.9***	56.6	-10.3
	N36	Phyllis McKinney/7202 Grand Ave	1	***67.3***	58.4	-8.9
	Feasibility					
	% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
NB3: Recommended Barrier Design	**Reasonability**					
	Number of receptors with at least 7 dB(A) reduction	7	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
	540	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**Yes**	
	13	Height, ft				
	7,020	Area, sq ft				
	$25	Noise Barrier Cost per sq ft				
	$175,500	Cost of noise barrier				
	7	benefited receptors				
	$25,071	Cost per benefited receptors				
	Other Considerations					
	Does this design pass the TNM Line of Sight?				**Yes**	

NB4: North side of OC Mainline Between Evins Avenue and Buckeye Road

Feasibility Criteria

Provides a minimum 5 dB(A) reduction for 40% of the impacted receptors.

Reasonability Criteria

Noise reduction design goal = At least 7 dB(A) for one benefited receptor.

Benefited receptor = Noise reduction of at least 5 dB(A).

Reasonable Cost per Dwelling Unit less than or equal to $35,000 per benefited receptor.

NB4: TNM Maximum Height Modeled - 15'

Noise Barrier 4					
Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
N50	City of Cleveland/2676 Grand Ave John Wynder/2678 Grand Ave	4	***65.5***	56.9	-8.6
N51	Diane Cobb/2672 Grand Ave Cuyahoga County Land Reutilitzation Corp/2668 Grand Ave	2	64.1	57.1	-7.0
N52	Christopher Scott/2658 Grand Ave	2	63.0	59.8	-3.2
N53	CLI Construction, INC./2661 Grand Ave	2	***69.1***	59.6	-9.5
N54	People of the Way Ministry/8634 Buckeye Rd	7	***67.5***	60.3	-7.2
Feasibility					
% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
Reasonability					
Number of receptors with at least 7 dB(A) reduction	15	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
829	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**Yes**	
15	Height, ft				
12,441	Area, sq ft				
$25	Noise Barrier Cost per sq ft				
$311,025	Cost of noise barrier				
15	benefited receptors				
$20,735	Cost per benefited receptors				
Other Considerations					
Does this design pass the TNM Line of Sight?				**Yes**	

NB4: Recommended Barrier Design

Noise Barrier 4					
Active Receivers	Owner/Address	Dwelling Units	w/o Barrier	w/ Barrier	Delta
N50	City of Cleveland/2676 Grand Ave John Wynder/2678 Grand Ave	4	***65.5***	58.7	-6.8
N51	Diane Cobb/2672 Grand Ave Cuyahoga County Land Reutilitzation Corp/2668 Grand Ave	2	64.1	58.3	-5.8
N52	Christopher Scott/2658 Grand Ave	2	63.0	60.6	-2.4
N53	CLI Construction, INC./2661 Grand Ave	2	***69.1***	60.8	-8.3
N54	People of the Way Ministry/8634 Buckeye Rd	7	***67.5***	61.9	-5.6
Feasibility					
% of impacted receptors with at least 5 dB(A) reduction	100%	Do 40% of impacted receptors receive 5 dB(A) reduction or more?		**Yes**	
Reasonability					
Number of receptors with at least 7 dB(A) reduction	6	Does at least one benefited receptor receive 7 dB(A) reduction or more?		**Yes**	
500	Length, ft	Is the 'Reasonable Cost per Dwelling Unit' less than or equal to $35,000 per benefited receptor receiving a minimum reduction of 5 dB(A) in the predicted noise level?		**Yes**	
13	Height, ft				
6,497	Area, sq ft				
$25	Noise Barrier Cost per sq ft				
$162,425	Cost of noise barrier				
15	benefited receptors				
$10,828	Cost per benefited receptors				
Other Considerations					
Does this design pass the TNM Line of Sight?				**Yes**	